

EXHIBIT C

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Subject Review Report of Sprafka Documents

Date June 30, 2023

EXECUTIVE SUMMARY

Sprafka case reports were reviewed to prepare this response. The following executive summary has been presented below and elaborated in the following pages. The question-in-hand (QIH) is –

“Would a 59 year old white woman in Minneapolis NA, experience knee pain implanted with ATTUNE TKA 4 years post-op than woman who never had TKA”

1. The **meta-analysis**, using the registry data from 3 continents, cannot be applied to Ms. Sprafka since the data ignored all the stakeholders, study population from around the world, only revision surgery as an intervention which reduces the heterogeneity and generalizability of the results to population and settings of interests, in this case 1 individual. Data extracted for the meta-analysis did not consider demographics, disease characteristics, comorbidities, enrollments, baseline measurements, exposures and interventions, outcomes, follow-ups and design elements, mainly because selected studies ignored them. Also, included studies were NOT “peer reviewed.” Swedish Arthroplasty Register is among the oldest, considers epidemiology details and outcome with respect to regions within Sweden, ignored. Therefore, registry data is incomplete to extend its application to the US population. In the presence of these and other limitations, the meta-analysis results cannot be applied to Sprafka.
2. A systematic review, of which meta-analysis a part, is incomplete as it does not include increased rates of aseptic loosening cases in recent TKA revisions with ATTUNE device based on clinical indications or evidence-base. **Literature review** of evidence-based, clinical indications of AL will provide answers to the above QIH since in the USA patient and healthcare provider decide.
3. The use of health data from across 3 continents for cross-border data sharing must comply with the **privacy and ethical considerations**. Patient privacy laws, such as General Data Protection Regulation – GDPR in the European Union and consent requirements should be taken into account while registry data is utilized for analysis and decision-making purposes. US Citizens from these continents whose data is included in the registry are protected per Health Insurance Portability and Accountability Act (HIPPA) and one cannot include those data. Therefore, the consent statements and inclusion and exclusion criteria needed to be shared with all stakeholders. If these do not exist, meta-analysis performed cannot be included.
4. What does **artificial intelligence “search”** show to the above question?

This report has been organized into the 4 main sections above, in each section several sub-sections were added to elaborate why a certain conclusion was derived.

1. Meta-analysis

1.1 Did you do your homework?

Extracted from **Title:** Effect Size and Meta-Analysis. ERIC Digest.

One meta-analysis of homework involving effect sizes of homework to be .15 for grades 4 to 6, .31 for grades 7 ERIC Resource Center www.eric.ed.gov effect Size and Meta-Analysis. According to this study, homework in high school produces a gain of about 24 percentile points, homework in the middle grades produces a gain of only 12 percentile points, and homework in grades 4 to 6 has a relatively small effect a percentile gain of 6 points on student achievement. Homework assigned but not graded or commented on generates an effect size of only .28; however, the effect size increases to .78 when homework is graded, and to .83 (a percentile gain of 30 points), when the teacher provides written comments. Data-sheets filled out by surgeons at the time of primary and/or revision surgery and entered into the register(s) are not signed-off by a supervisor (similar to ungraded homework), thus there is a high chance that errors (human factors related) may seep-in, thus validity and repeatability of data entered may be flawed.

Finland has no homework and world's best education, yet in the US each school is different, 93% of 4th graders get homework whereas 7% get none. This discrepancy was interpreted in terms of technique of meta-analysis used may have injected useful scientific rigor into reviews of educational research, but it also has some limitations. For example, a synthesis of research studies may provide evidence about the overall effectiveness of a method, but not the specific details that would help guide implementation.

*Are some instructional strategies more effective in certain subject areas? *Are some instructional strategies more effective at certain grade levels? * Are some instructional strategies more effective with students from different backgrounds? * Are some instructional more effective with students of different aptitude? A good meta-analysis may point to the need for more focused and refined research studies to answer those questions. It's also important to remember that it is provisional, representing the best evidence at the time it was conducted, but subject to change in the face of the evolution of the knowledge base.

What can go wrong with school-to-school variability in the US? Imagine adding data from rest of the world to it to apply to one pupil, her/his learning outcome in one school in a neighborhood in a town/city, State and other inherent variabilities that exist with demography and economical standing. Therefore, we could not drop homework all together in the US and establishes that meta-analysis results cannot be applied even in the simplest of the situations, where 100% of the student supports "no homework."

This publication was prepared with funding from the Office of Education Research and Improvement, U.S. Department of Education, under contract ED-99-CO-0032. The opinions expressed in this report do not necessarily reflect the positions or policies or the U.S. Department of Education. Permission is granted to copy and distribute this ERIC/AE Digest.

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ERIC Resource Center www.eric.ed.gov

ED470590 2002-12-00 Effect Size and Meta-Analysis. ERIC Digest.

1.2 Systematic Review

Systematic Review is a scientific approach that uses reviews and evidence using a technique (Committee on Standards, 2011). A structured search of the literature using Medline (which is voluminous, 20 million items, where it is estimated that nearly 500,000 new articles are added every year in the National Library of Medicine) conducted to answer a focused question, in this case, QIH. This is an involved process in which multiple people participate, often expensive, and time-consuming because one has to prepare a topic (QIH), search the literature, screen the relevant articles, data extraction, analysis and reporting without biases. One can follow Institute of Medicine's Standards for Systematic Reviews of Comparative Effectiveness Research (Committee on Standards 2011), <https://methods.cochrane.org/sdt/handbook-dta-reviews>, Agency for Healthcare Research and Quality (2014) and other resources. The components of a systematic review are shown in Figure 1.2.1.

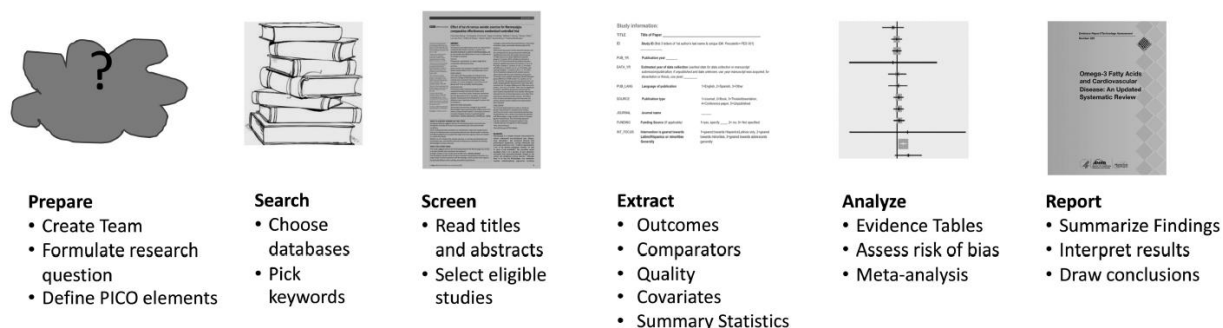


Figure 1.2.1. Components of a systematic review, taken from DOI: 10.1201/9781315119403-1

For scientific validity and impact of the review the research team needed to consult with all the stakeholders (patients, clinicians, nurses/caregivers, epidemiologists, policy makers, insurance providers, manufacturer(s) and regulators) to ensure checks and balances. If meta-analysis fails to address the quality of life of the patient in reducing the pain, improving sleep, increasing energy and activities of daily living, it is of little benefit to the patient and review becomes *invalid*. A very broadly defined question, as occurred in this case, does not provide precise answer to the QIH and vice-versa. The report fails to identify the key elements included such as population (why international participants), interventions (only revision surgery), any comparators, outcomes (for example, how pain was measured for each participant, analog pain scale, SF-36 etc and how those compared with Sprafka) and study design (sample size, follow-up duration etc). Homogeneity of effects across geographic, economic, cultural, healthcare provided by Government vs insurance and other parameters will be difficult to test. All the elements included in the review were *flawed* using the registry data since it does not include follow-up (only revision surgery data entered in the register). Since manufacturer used its resources to prepare the report, not an independent team, it only establishes bias and conflict of interest in this case, even-though the author of the report is a respected researcher.

Patient involved in this research had been seen by physicians on numerous occasions. The meta-analysis needed to consider those follow-up visits in developing conclusions. The report components were further examined in the following pages as follows:

Table 1.2.1. Specific aspects of report and author's response summarized

Report	Responses
P 1-2	Dr. Holy is a highly established researcher and J&J administrator.
P-3 A meta-analysis was conducted using data from available.	Why meta-analysis framework?
orthopedic joint registries	With varying degree of reporting at each country
Risks for all-cause revision were analyzed	Risk was not defined, across country or all recipients of same device, age, demography, comorbidities, predispositions, etc At the onset of pain? Not reported
P-4: The cumulative hazard for all-cause revisions for patients with cemented primary Attune from the NJR dataset was not different from that reported in the meta-analysis for patients with control knee implants, at similar time points and for similar constructs.	Conclusions without citations or tabulated raw data
35.3% of all revisions occur less than 2 years after TKA, and 60.2%, within 5 years. Approximately 31% of all revisions are associated with aseptic loosening (AL).	Denominator, total number of revisions, not spelled out. Are the patients informed about this high rate before they received the procedure?
P-4,5. From the UK: the National Joint Registry (NJR) - From the Netherlands: the Landelijke Registratie Orthopedische Implantaten (LROI) From Germany: the Endoprothesenregister Deutschland GmbH (EPRD) - From Switzerland: the Geneva Registry - From Australia: the Australian Orthopaedic Association National Joint Replacement Registry (AOANJRR) - From the United States: the Kaiser Registry, the Michigan Arthroplasty Registry Collaborative Quality Initiative (MARCQI) registry, the American Joint Replacement Registry (AJRR) - From New Zealand: the New Zealand Joint Registry (NZJR)	Registers from 3 continents referred. Reporting rate of each not included. US reporting from 3 registers establishes that relevant data is incomplete with AJRR with less than 60% of reporting for revision TKA
P-5 Research Questions risk ratios for all-cause revisions following primary cemented TKA in patients	"Risk" was not fully defined, that it only meant to cover revisions. Insufficient data those who are experiencing pain and other symptoms
P-5 Primary Objectives	World data enables meta-analysis to be performed to develop policies to distribute healthcare by government.
P-6 Meta analysis – methods	Irrelevant

P-10 These very small numbers mean that from one report to the next, numbers may or may not reach significance and a very small variation in numbers can tip the balance of being significant. More specifically: of all the surgeons that contributed cases (for PS FB constructs: 325 surgeons, for all Attune: 677 surgeons): patients from only 5 surgeons accounted for 58% of all aseptic loosening cases.	Is it fair then to say that the AL was local phenomenon in the US?
P-11 Conclusions: An increased risk of all-cause and TAL/FPTAL revisions was identified for a single Primary Lead (a.k.a. surgeons/consultants), suggesting an operator effect	Results obtained cover "Individual" level for the surgeon, hospital, town/city, State and country
Therefore, based on our results, we did not find evidence for increased risk of aseptic loosening across all included registries	Even though AL was the main reasons for revisions across registries
P-11, Authors evaluated all revisions from 1.5 up to 5 years post-implantation and concluded that revision rates for Attune were comparable to those of other knee systems.	Conflict of interests for Vasarhelyi <i>et al.</i> [11]
P-12 The particular mechanism of loosening (e.g., debonding) is not reflected in registry data.	Engineering of debonding could have been elaborated in further
P-13 <i>In addition to age, other patient-related comorbidities and clinical aspects may affect a patient's risk for aseptic loosening. Recent studies suggest cement type and cementation method are associated with aseptic loosening risks.</i> A systematic review conducted by Cherian <i>et al.</i> evaluated risk factors for aseptic loosening following both TKA and total hip arthroplasty (THA) procedures. (16) Although there were conflicting results across studies, some investigations reported that patient-related factors were associated with AL. In a commentary related to the review, Dr. Ryu concluded that: "many host (and other clinical) factors can be interrelated, making it difficult to quantitatively analyze how much a single host factor contributes to loosening. Additionally, statistical pitfalls can complicate matters, in particular insufficient statistical power, resulting in the failure to detect the	AL-Clearly established as an evidence based phenomenon clinically. Stages of AL was a result of metal/PMMA -interface mismatch in terms of adhesion -expansion coefficients -micromotion -stiffness differences among bone-metal-PMMA -pain and other discomfort -lack of cement pockets in metal -load transfer from bone-to-implant-to PMMA -Spalling and cracking -pulling-off of implant at lowest of the forces (below 0.8 MPa)* -documented cases of debonding (area over 42.9%)* * https://www.arthroplastytoday.org/article/S2352-3441%2822%2900140-6/fulltext

influence of one or more factors that could result in an increased risk of loosening.” (17)	
P-13 This study further confirms an operator effect, and the importance of the cement brand, in predicting risks of aseptic loosening	Does J&J recommend which brands to use?
P-13 Patient Knee Implant Performance tool (PKIP). This patient-reported outcomes measure (PROM)	Was this patient given this information If yes, who could have followed it up?
P-14 patients treated with Attune were discharged faster [23]	Did that result in higher AL cases? COI?
P-14, 24-27 irrelevant	COI with these reports

1.3 Literature Search

The motivation for searching the literature to the QIH should have included Medline, EMBASE, Cochrane Controlled Trials Registry, clinicaltrials.gov, books and proceedings in medicine that are “peer-reviewed” together with the “non-peer-reviewed” data. The Holy et al, mainly used the latter that are so-called gray literature as a result the **report is NOT a systematic review** and lacked input from specialists like librarians who could have constructed efficient algorithms for optimized sensitivity and specificity. Therefore, it is not possible to reproduce the search and collection of the documents used in their review.

A human subject study of this magnitude access to ethical approval proposal, consent form, inclusion and exclusion criteria needed to have been exhibited in their report.

Other components of 1.3 includes PICOS elements; the report needed to define the following:

Population (demography details; why specific data was collected and how this population helps QIH)

Interventions used (Revision surgery) since no follow-ups are recorded, it does not help the QIH.

Comparators needed to be defined to address QIH

Outcomes needed to be specific to a patient with pain score, function, sleep, activities of daily living. It is worth noting that outcomes are human factors related, in that a clinician, teacher or policymaker may view some outcomes differently; than patient and student who may view other outcomes more importantly. Therefore, human factors such as those who enter the data in register and their physical condition at the time of data entry play a part in the analysis of such data from thousands of hospitals, in multiple countries and continents.

Study design needed to restrict the sample size and follow-up duration.

Many of these parameters were incomplete therefore, the conclusions drawn do not apply to QIH.

Once the literature collected from the above process how the following steps were handled? Access to the raw data will be very beneficial to learn of the conclusions drawn. How many items (for example, 33) each report contributed to the analysis results? We need to know what those 33 items were?

Screening: the collected articles needed to have been statistically analyzed for their usability. The articles significantly different than the QIH needed to be filtered and rest included for the reporting. Researchers needed to validate each study with the inclusion and exclusion criteria.

Extraction: demographics, disease characteristics, comorbidities, enrollments, baseline measurements, exposures and interventions, outcomes, and design

Risk and Bias: quality and validity of the included data. If only a subset of data, for example, loosening from infection, pain, wear, fracture and other reasons for revision were identified as independent or interactive mode ignored, raising bias towards QIH.

Analysis: involves both qualitative and meta-analysis (MA). The extent to which a MA captures the truth about the treatment effects depends on how accurately input parameters represented the populations and settings for which inferences must be made. Since variations in healthcare systems and practices are different in the EU and US; how care, insurance, coverage, reimbursement, regulatory frameworks, and guidelines homogenized to universalize the outcomes?

Joint registry data from different countries may have variations in data collection methods, definitions, and coding systems. This will make it impossible to compare and combine data. What standards were used to harmonize data ensuring that interoperability would be meaningful across the continents. How those trends were validated for countries within Australia, Europe and USA.

1.4 World-wide Orthopaedic Registers

The American Joint Replacement Registry is a new effort among the multiple stakeholders from patient, surgeon, industry, regulators, hospitals, professional societies and other entities. Since AJRR is new register, compared to other established registers the reporting rates are below 60% for revision TKA. With 40% of surgeries not added to the register, outcomes from 60% cannot be generalized to all TKA recipients in the US. Only about 25% of patients participate in 1-year post-op. World-wide reporting in registers has been to a varying degree, where European registers enter high percent of the data, 96-98% due mainly to the provider there is Government that provides healthcare, thus these data help in developing policies when a surgery will be approved. Register reporting rate is as follows:

Table 1.4.1. Reporting rate in different register

Country	Year Registry Began	Year of Registry Used	Reporting Rate
Canada	2001	2018	72%
Australia	2017	2018	NA
New Zealand	1999	2017	20%
Romania	2003	2010	98%
Denmark	1997	2010	95%
India	2006	2018	na
Lithuania	2010	2018	40%
Norway	2018	2018/2019	67%
Pakistan	2014	2017/2018	Na
Scotland	2006	2017	67%
Slovakia	1979	2011	43%
Germany	2010	2019	66.6%
Sweden	1979	2015	

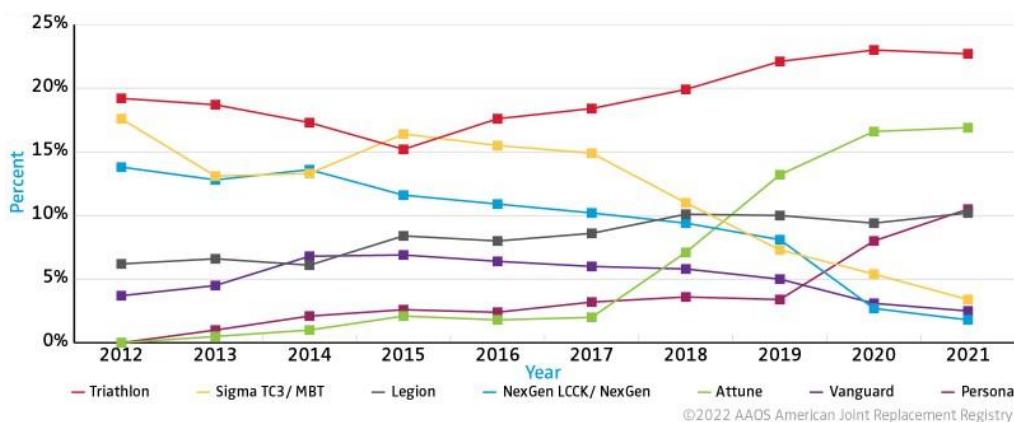
*Denotes data unknown/unavailable

Figure: Source: Authors.

Sweden is the oldest register and enters 97-98% of all TKA data and all registers ignore 1 year mortality rates post total joint replacement. *With these reporting rates, meta-analysis results do not apply to Sprafka.*

[The AAOS American Joint Replacement Registry](#) has recently published 2022 report from which two charts have been presented below showing the introduction of ATTUNE TKA and growth in market and improvement felt after TKA. One can clearly see the market share from 2012 to 2017 was minimum level, rising steadily after the tibial component was redesigned, through 2020 to 17%. This device has shown promise that Pandemic slowed down use of other products, ATTUNE usage continued to grow. However, early failures, post-op 2-5 years may have started to occur, that caused a plateau in the use between 2020 and 2021. Since the device is newer than others, only recent literature contains the independent study cases, outside of registry, showing high rates of aseptic loosening. Since register only enters either primary or revision surgery data, the outcome (pain scores, x-ray, width of radiolucent lines and other conditions) after primary surgery leading to revision is ignored. These are clinical, evidence-based conditions and must be treated as clinical indications. One-year mortality cases not included in the register as well as other cases where a “person” isolating to not seek further treatment or intervention. Therefore, registry data is incomplete to extend its application to the US population.

Figure 3.30: Revision Total Knee Arthroplasty Femoral/Tibial Component Combinations by Year, 2012-2021 (N=47,916)



AAOS
American Academy of
Orthopaedic Surgeons

AJRR
American Joint Replacement
Registry

Figure 1.4.1. AJRR reported use of ATTUNE device in revision TKA

Less than 25% of patients who filled out pre-operative and 1-year post-operative survey KOOS, JR. (Knee disability and osteoarthritis outcome score) for 55-64 age group, observed meaningful improvement. See Figure 1.4.2 (86.1%). However, the remainder of 15% did not notice meaningful improvement. When extended to 100% of TKA recipients, meaningful improvement cases will be significantly lower than 86% with the participation more patients (75%) and 1 year mortality data included.

Table 3.10: Age-stratified Change Between Preoperative and 1-Year Postoperative PROM Scores after Primary Knee Arthroplasty by PROM for Patients 55 Years and Over, 2012-2021

Patient-Reported Outcome Measure (PROM)	PROM Component	Age Group (Years)	Patients with Preoperative Score	Patients with Linked Postoperative Score	Response Rate, Percentage of Patients Who Completed a Preoperative and 1-Year Score	Patients with Meaningful Improvement*
KOOS, JR. (Knee Disability and Osteoarthritis Outcome Score)	Score	55-64	19,438	4,270	22.00%	86.10%
		65-74	31,476	8,487	27.00%	85.40%
		75-84	15,512	3,941	25.40%	84.60%
		>85	1,906	439	23.00%	85.40%
PROMIS-10 (Patient-Reported Outcomes Measurement Information System 10)	Mental T	55-64	13,978	3,092	22.10%	36.50%
		65-74	23,447	6,543	27.90%	32.40%
		75-84	11,582	3,137	27.10%	28.90%
		>85	1,476	338	22.90%	26.60%
	Physical T	55-64	13,969	3,090	22.10%	67.20%
		65-74	23,447	6,544	27.90%	65.60%
		75-84	11,578	3,137	27.10%	61.00%
		>85	1,476	338	22.90%	57.70%

*Meaningful improvement was calculated by minimal clinical important difference (MCID). MCID was determined to be a positive change score of half the pooled standard deviation.

©2022 AAOS American Joint Replacement Registry

AAOS
American Academy of
Orthopaedic Surgeons

AJRR
American Joint Replacement
Registry

Figure 1.4.2. Year 1 post-operative survey results showing meaningful improvement for 25% of the cases.

Reviews of global registries show that for TKA the loosening is the primary reason, however, total hip replacement revisions occur due to infection.

Germany- Knee

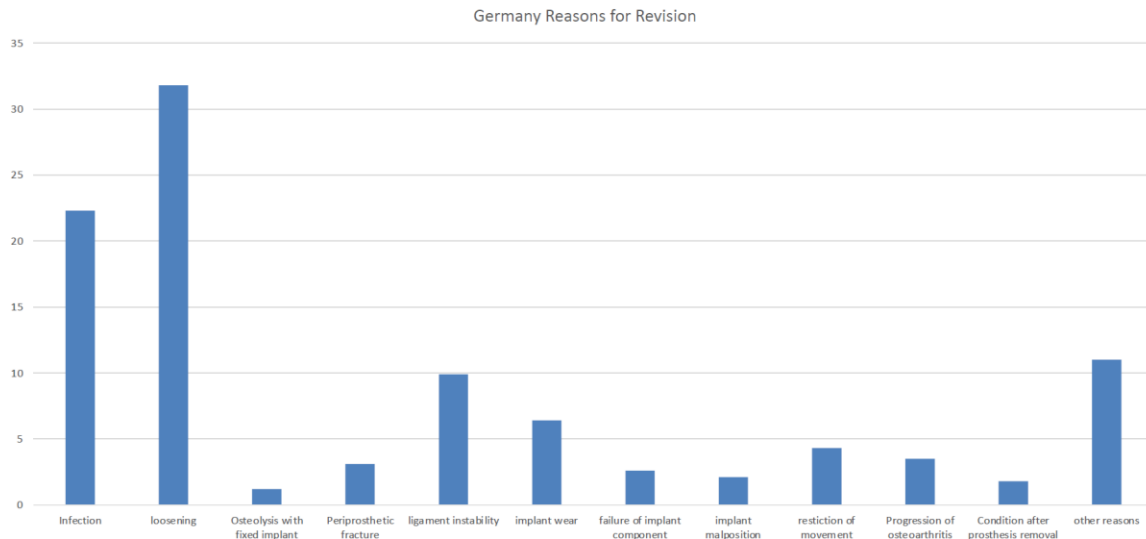
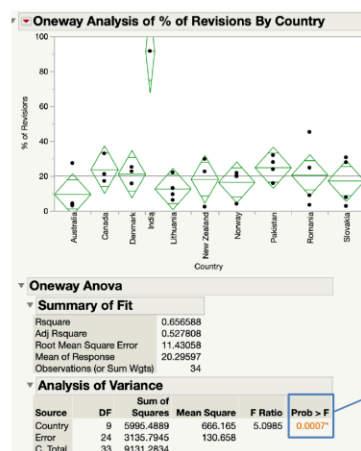


Figure 1.4.3. German register was selected in random to show the reasons for revisions of TKA. Loosening is the primary reason.

If world-wide registry data aggregated and variance of the percent of revisions compared by country, there is a significant difference ($p=0.0007$), meaning only select countries would show comparability.

Comparison All Countries- Knee Conclusion

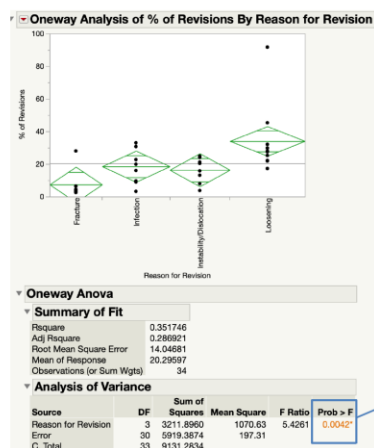


From the analysis of variance of the % of revisions by country, it can be concluded that there is a significant difference between the different countries. This can be seen by the p-value of 0.0007. This means that at least one of the countries were significantly different than the other countries. Further analysis is needed to determine which countries are significantly different from the others.

Figure 1.4.4. Analysis of variance results of world-wide registry data of percent revisions

If world-wide registry data aggregated and variance of the percent of revisions **by reason** compared by country, there is a significant difference ($p=0.0042$), meaning only select countries would show comparability. Therefore, registry data is incomplete to extend its application to the US population.

Comparison All Reasons- Knee Conclusion



From the analysis of variance of the % of revisions by reason, it can be concluded that there is a significant difference between the different reasons for revision. This can be seen by the p-value of 0.0042. This means that at least one of the reasons for revisions were significantly different than the other reasons. Further analysis is needed to determine which reasons are significantly different from the others.

Figure 1.4.5. Analysis of variance applied to reasons for revisions showing a significant difference ($p=0.0042$).

Figures 1.4.4 and 1.4.5 clearly illustrate that among the countries data can be significantly different as well as their reasons for revision. Further discussion can be extended that at least one of the countries exhibited more failure rates and one reason, e.g., loosening may be significantly different than other reasons.

1.5 Registry Data Entry Forms

The registry forms from UK have been selected as EXHIBIT 1 and 2 representing K1 for primary TKA surgery and K2 for revision TKA. In between, the follow-up data is NOT added to the register. American system of patient chart available to individuals as “mychart” contains basic data which is voluminous. Compared to what is presented in “mychart” these registry data-entry forms and the data entered do not represent the health condition of an individual. Therefore, registry data is incomplete to extend its application to the US population. This can be verified with the orthopaedic surgeon expert.

American Medical Association disqualifies medical qualifications from rest of the world unless they pass the United States Medical Licensing Examinations (USMLE). This takes several years followed by 5-7 years of residency and additional years in fellowship. If the medical qualifications of surgeons performing surgery else-where is not equivalent to US – MD (minimum degree), how their data be applicable?

1.6 Swedish Register

The 2021 Swedish Arthroplasty Register report has been presented as EXHIBIT 3. The oldest among registers, enters the data based on region within Sweden, hospital, surgeon, demography and epidemiology. Since these variations are significant within a small area (equivalent to one of our States), this may have been the most important data set and was not included in the meta-analysis. Therefore, registry data is incomplete to extend its application to the US population.

1.7 SUMMARY

- Conceptual aspects of the report are flawed as part of the PICOS, the patient was not contacted as a constituent, to apply the results to her. Conclusions drawn with the use of registry data with regards to AL revision rate 2.5% or less requires long-term data that they do not have YET.
- Even though the statistical methods used were employed in clinical trials, where parameters are controlled, register data do not represent that. Heterogeneity from world-wide data sources, how it was handled needed to be discussed, if only one parameter such as revision surgery used in the analysis, it cannot be generalized to apply to one individual.
- Consent, Inclusion/exclusion criteria needed to be defined, if any, along with ethical criteria used. The data cannot be used to conclude statistical significance.
- It must be emphasized that the purpose of undertaking a meta-analysis remains controversial between the rest of the world (national health service that provide healthcare) and the USA, the results are used to develop policies and not applicable at individual patient level. Homework example demonstrates that meta-analysis results cannot be applied to simplest of the situations.
- Registry data from 3 continents used do not spell out the inherent variability that exists epidemiologically at defined population, individual patient, operators, hospital, neighborhood, city/town, State, Country and demographic variabilities, comorbidities, predispositions, substance usage, economic standing, racial inequality, and numerous other variabilities. Therefore, global data cannot be applied to an individual in a State in the USA who obtained services from an operator, hospital, city/town, neighborhood. We have shown in our analysis of the registry data that within countries there can be significant differences, that then will limit data usage as well as reasons for revisions differences if significant in one country, that too will limit the data usage.
- “Risk” not properly defined. It is considered 1 (absolute) when a revision occurred. However, those who are at the early stages of experiencing pain, and not been for a check-up, what is the risk (below 1)? The exclusion of follow-up raises bias and completeness of the data.
- Aseptic loosening is a loss of fixation, therefore, is independent of global-patient base. It is individual, occurring locally to a patient handled by patient and healthcare provider model, where meta-analysis does not apply. The dislodging of cement and metal occurs via initiation and propagation of a crack or multiple cracks, which is a time dependent process. AL is the prime reason for revision of TKA. World-wide ATTUNE cases leading to AL and revisions needed to be determined and tabulated from most current literature.

2. Literature Review of Aseptic Loosening

2.1 Literature Review

Since the recent literature, independent clinical evaluations, includes instances of AL in ATTUNE TKA, there was/is a need to conduct scientific literature review. As indicated in Section 1.3 that a literature review is a scientific task that involves more than one researcher, J&J could have conducted that in a way that could have been meaningful and useful to different constituents' patient, providers, operators, academics, and other communities. Since this task is often expensive and time consuming, it was unethical to not conduct or if conducted to not share the report and its' findings. In lack of this information, an attempt was made to conduct a limited literature search. While it is not the intent of this researcher to search/screen/extract/risk and error/analysis and produce the report, our scientific literature search shows that independent clinical indication of AL cases with ATTUNE tibial tray are higher than that previously reported. Since Registry data includes at least 1- to 2-year-old information, these instances are not included in registry. Also, it should be noted that registers do not record the follow-up diagnosis and clinical reasons for the follow-up, debonding, and it leading to component pull-off, actual cases of AL are likely to be much higher. With due time these numbers will become available. Therefore, the registry data used to favorable conclusions may be misleading.

Literature search using PubMed and Web of Science was conducted. Following results obtained.

Filter choices:

- Female
- Middle aged (45-64)
- Middle aged and elderly (45+)
- a BMI filter is not offered, abstracts sometimes mention BMI ranges but not always

[7 PubMed matches](#), show 6 articles were between 2021 to 2023 with the exception of 1 from 2018.

Consider these numbers for various searches.

ATTUNE ("total knee arthroplasty" or TKA) [\[78\]](#) articles]

filtered for female [\[31\]](#)

filtered for middle aged 45-64 [\[27\]](#)

filtered for gender and age [\[26\]](#)

restricting by search term "aseptic loosening" [\[1\]](#)

Other search combinations, with gender and age filters on.

- ("total knee arthroplasty" or TKA) AND PMMA [\[19\]](#)
- ("total knee arthroplasty" or TKA) AND ZimmerBiomet [\[14\]](#)
- ("total knee arthroplasty" or TKA) AND NEXGen AND aseptic [\[17\]](#)
- ("total knee arthroplasty" or TKA) AND Striker AND aseptic [\[0\]](#)

These results clearly show that ATTUNE, in its short history, has been 5 times as much mentioned in the body of literature.

Few randomly picked research articles demonstrate AL highly present in select studies; therefore, there is a need to summarize the AL cases in ATTUNE devices. Often the details are available after purchase of the articles. The references below only demonstrate that AL cases are quite prevalent in the literature and must be respected, deserving of a scientific investigation.

Willburger, R.E., Oberberg, S. Early and mid-term results with the ATTUNE total knee replacement system compared to PFC Sigma: a prospective comparative study. *J Ortho. Surg Res* **17**, 509 (2022).

<https://doi.org/10.1186/s13018-022-03397-7> (30 cases of AL)

van Otten TJM, van Loon CJM. Early aseptic loosening of the tibial component at the cement-implant interface in total knee arthroplasty: a narrative overview of potentially associated factors. *Acta Orthop Belg.* 2022 Mar;88(1):103-111. doi: 10.52628/88.1.13. PMID: 35512160. (reviewed 12 studies with 299 cases of AL)

Zach C. Cox, Stephen M. Engstrom, Andrew A. Shinar, Gregory G. Polkowski, J. Bohannon Mason, J. Ryan Martin, Is cement mantle thickness a primary cause of aseptic tibial loosening following primary total knee arthroplasty? *The Knee*, Volume 40, 2023, Pages 305-312, ISSN 0968-0160, <https://doi.org/10.1016/j.knee.2022.12.003>. (216 revisions due to AL)

Where Is the “Weak Link” of Fixation in Contemporary Cemented Total Knee Replacements? J. Ryan Martin, MD Jesse E. Otero, MD, PhD J. Bohannon Mason, MD Thomas K. Fehring, MD *The Journal of Arthroplasty* February 12, 2021 DOI: <https://doi.org/10.1016/j.arth.2021.02.029> (Retrospective analysis of 140 knee revisions).

WOS lists [11] articles on the topic of (ATTUNE "total knee arthroplasty" aseptic) but NO review articles suggesting a synthesis of many resources.

In addition to a scientific search with PUBMED, which includes Medline, WOS, google search and science direct also pull numerous articles (including the above and others) that show that the instances of AL in ATTUNE system is higher than that reported in the report. There are multiple studies showing hundreds of such debonding cases that need to be tabulated and further researched.

3. Privacy and Ethical Considerations

3.1 The use of health data from across 3 continents for cross-border data sharing must comply with the privacy and ethical considerations. Patient privacy laws, such as General Data Protection Regulation – GDPR in the European Union and consent requirements should be taken into account while registry data is utilized for analysis and decision-making purposes. US Citizens from these continents whose data is included in the registry are protected per Health Insurance Portability and Accountability Act (HIPPA) and one cannot include those data. Therefore, the consent statements and inclusion and exclusion criteria needed to be shared with all stakeholders.

3.2 We would like to request the following approvals, if obtained, to conduct the analysis and the decision that was arrived at;

- Permission/approval to use registry data
- Consent to use the data of registry participants
- inclusion and exclusion criteria
- Article 35 of GDPR Data Protection Impact Assessment (DPIA) reads - If you're processing personal data related to "racial or ethnic origin, political opinions, religious or philosophical beliefs, or trade union membership, and the processing of genetic data, biometric data for the purpose of uniquely identifying a natural person, data concerning health or data concerning a natural person's sex life or sexual orientation"
In other cases, "where the high-risk standard is not met, it may still be prudent to conduct a DPIA to minimize your liability and ensure best practices for data security and privacy are being followed in your organization. Remember, most data breaches [trigger](#) certain regulatory requirements (gdpr.eu)"
- If an American citizen underwent TKA in EU, her/his data added in register, still her/his record will be protected by HIPPA and cannot be used for the purposes of this analysis.

In Summary, if compliance needed and has not been obtained, the registry data cannot be used.

4. Artificial Intelligence Assisted Search Results

4.1 Search chat: "Would a 59 year old, white woman in Minneapolis NA, experience knee pain implanted with ATTUNE TKA 4 years post-op than woman who never had TKA"

The experience of knee pain can vary greatly among individuals, and it is influenced by various factors. Having a knee replacement surgery, such as the ATTUNE Total Knee Arthroplasty (TKA), is intended to alleviate knee pain and improve joint function. However, there is still a possibility of experiencing knee pain after the surgery.

In general, individuals who have undergone knee replacement surgery may experience some level of discomfort or pain, even years after the procedure. This can be due to factors such as normal wear and tear on the implant, inflammation, changes in the surrounding tissues, or the development of other conditions like arthritis.

On the other hand, a woman who has never had knee replacement surgery may or may not experience knee pain, depending on various factors such as her overall health, lifestyle, and any pre-existing conditions.

It is worth noting that while knee replacement surgery aims to alleviate pain and improve joint function, it is not a guarantee that all pain will be completely eliminated. The success of the surgery and the level of pain experienced post-operatively can vary from person to person.

If a person who has undergone knee replacement surgery, such as the ATTUNE TKA, is experiencing knee pain four years after the procedure, it is advisable for them to consult with their healthcare provider. The healthcare provider can evaluate the specific situation, conduct a physical examination, and possibly order further tests to determine the cause of the pain and recommend appropriate treatment options.

[ChatGPT May 24 Version](#)

4.2 Search chat “Clinical indications of aseptic loosening following ATTUNE implantation cases are higher than presented in orthopaedic registers”

“According to the web search results, aseptic loosening refers to the failure of fixation at the bone-implant interface, with resultant micro- or macromotion of the implant relative to the adjacent bone. It is one of the leading causes of revision surgery for total knee arthroplasty (TKA). The ATTUNE Knee System is a novel uncemented rotating platform knee system that was introduced in 2012 with features aimed at addressing cement adhesion and aseptic loosening. However, there have been reports of early failures due to tibial baseplate debonding at the implant-cement interface of the ATTUNE Knee System. One study found that low-volume surgeons and one specific brand of high-viscosity cement were risk factors for aseptic loosening with the ATTUNE Knee System. Another study reported that clinical indications of aseptic loosening following ATTUNE implantation cases were higher than presented in orthopaedic registers. However, there are no clinical follow-up studies reporting results of the uncemented version of the ATTUNE Knee System, and more research is needed to evaluate its long-term performance and patient satisfaction.”

Powered by AI Bing May 24, 2023.

4.3 Search chat same question as 4.2

Chat GPT May 24 Version

Aseptic loosening is a potential complication that can occur following total knee replacement surgery, including the use of the ATTUNE implant. Aseptic loosening refers to the loosening of the implant components without the presence of infection. It can lead to pain, instability, and reduced function of the knee joint.

Orthopaedic registers, such as national joint replacement registries, are valuable resources for tracking the outcomes of joint replacement surgeries and monitoring implant performance. They provide information on the number of cases, complications, and revision rates associated with specific implant systems.

However, it is possible for the clinical indications of aseptic loosening following ATTUNE implantation to be higher than what is presented in orthopaedic registers. There could be several reasons for this discrepancy:

1. Underreporting: Not all cases of aseptic loosening may be accurately reported to the orthopaedic registers. Surgeons, hospitals, or patients may fail to report cases of implant failure or revision surgery, leading to an incomplete representation of the true incidence.
2. Time lag: Orthopaedic registers typically have a time lag between data collection and reporting. Newer implant systems, such as ATTUNE, may have been introduced relatively recently, and the available registry data may not capture the most up-to-date information on their performance.
3. Independent studies and publications: Clinical indications of aseptic loosening may be reported in independent studies or publications that are not included in orthopaedic registers. These studies can provide additional insights and may report different outcomes compared to registry data.
4. Variations in patient factors and surgical techniques: The performance of any implant can be influenced by various patient-related factors (such as age, activity level, and overall health) as well as surgical techniques employed. These factors may differ among different patient populations and surgeons, leading to varying clinical outcomes.

It is important to note that the information provided here is based on the knowledge available up until September 2021. As medical research and clinical practice evolve, new data may emerge, and it is always recommended to consult with healthcare professionals and rely on the most recent and relevant evidence when making decisions about implant choices or treatments.

4.4 Chat GPT May 24 Version “Would a 59 year old, white woman in Minneapolis NA, experience knee pain implanted with cemented ATTUNE TKA 4 years post-op than woman who had cementless ATTUNE TKA”

As an AI language model, I can provide general information, but I am not able to provide specific medical advice or predict individual experiences. The impact of knee replacement surgeries, such as cemented or cementless ATTUNE TKA (Total Knee Arthroplasty), can vary from person to person.

However, I can offer some general insights. Both cemented and cementless knee replacements have their advantages and potential drawbacks. In a cemented knee replacement, bone cement is used to secure the prosthesis to the bone. In a cementless knee replacement, the prosthesis has a porous surface that allows the bone to grow into it, providing stability.

While both methods have been used successfully in knee replacements, there are factors that may influence the experience of knee pain after surgery, including the individual's overall health, lifestyle, weight, activity level, and the expertise of the surgeon. Pre-existing conditions, such as osteoporosis or osteoarthritis, can also impact the outcome.

It's important to note that knee pain can have various causes beyond the type of knee replacement, including inflammation, infection, wear and tear, or other complications. If you are experiencing knee pain or have concerns, it is advisable to consult with a healthcare professional or orthopedic specialist who can evaluate your specific situation and provide appropriate guidance. They will be able to consider your medical history, conduct a physical examination, and order any necessary diagnostic tests to determine the cause of the pain and recommend suitable treatment options.

Exhibits

1. MDS Version 7.0-K1-V 5.0 (Hardcopy)
2. MDS Version 7.0-K2-V 6.0 (Hardcopy)
3. SAR-Annual-Report-2021-SJIAFmIRI5 (Hardcopy)



National Joint Registry

www.njrcentre.org.uk

Working for patients, driving forward quality

MDS VERSION 7.0

Form: MDSv7.0 K1 v5.0

Knee Operation

Patient Addressograph

K1 Knee Primary

Important:

Please tick relevant boxes. All component stickers should be affixed to the accompanying 'Minimum Dataset Form Component Labels Sheet'. Please ensure that all sheets are stapled together.

All fields are Mandatory unless otherwise indicated

REMEMBER! MAKE A NOTE OF THE NJR REFERENCE NUMBER WHEN YOU ENTER THIS DATA

NJR REF:

PATIENT DETAILS

NJR Patient Consent Obtained	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Not Recorded <input type="checkbox"/>
If 'Yes' or 'No' was selected for patient consent above, was consent provided by a consultee on behalf of the patient?	Yes <input type="checkbox"/>	No/Not Known <input type="checkbox"/>	This refers to NJR consent being provided by a third party on behalf of the patient, not the 'consent to operate' normally obtained by the consultant. If an 'NJR Patient Consultee Declaration Form' has not been completed, this section should be completed as 'No/Not Known'
Body Mass Index (enter either H&W OR BMI OR tick Not Available box)	Height (IN M) Weight (IN KG)	BMI	Not Available <input type="checkbox"/>

PATIENT IDENTIFIERS

Forename(s)			
Surname			
Gender	Male <input type="checkbox"/>	Female <input type="checkbox"/>	Not Known <input type="checkbox"/> Not Specified <input type="checkbox"/>
Date of Birth	DD/MM/YYYY		
Patient Postcode	Overseas Address <input type="checkbox"/>		
NHS Number OR National Patient Identifier (if available)			
Patient Hospital ID			
Patient email address (optional)			
Patient mobile phone number (optional)			

OPERATION DETAILS

Hospital			
Operation Date	DD/MM/YYYY		
Anaesthetic Types	General <input type="checkbox"/>	Regional – Nerve Block <input type="checkbox"/>	Regional – Spinal (Intrathecal) <input type="checkbox"/>
	Regional - Epidural <input type="checkbox"/>		
Patient ASA Grade	1 <input type="checkbox"/>	2 <input type="checkbox"/>	3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/>
Operation Funding	NHS <input type="checkbox"/>	Independent <input type="checkbox"/>	

SURGEON DETAILS					
Consultant in Charge					
Operating Surgeon					
Operating Surgeon Grade	Consultant <input type="checkbox"/>	SPR/ST3-8 <input type="checkbox"/>	F1-ST2 <input type="checkbox"/>	Specialty Doctor/SAS <input type="checkbox"/>	Other <input type="checkbox"/>
First Assistant Grade	Consultant <input type="checkbox"/>	Other <input type="checkbox"/>			

KNEE PRIMARY PROCEDURE DETAILS					
Side	Left <input type="checkbox"/>	Right <input type="checkbox"/>			
Indications for Implantation (select all that apply)	Osteoarthritis	<input type="checkbox"/>	Rheumatoid Arthritis	<input type="checkbox"/>	
	Avascular Necrosis (AVN)	<input type="checkbox"/>	Previous Trauma	<input type="checkbox"/>	
	Other Inflammatory Arthropathy	<input type="checkbox"/>	Other	<input type="checkbox"/>	
	Previous Infection	<input type="checkbox"/>			

PRE-OPERATIVE RANGE OF MOVEMENT					
Fixed Flexion Deformity (degrees)	Less than 10 <input type="checkbox"/>	10 to 30 <input type="checkbox"/>	Greater than 30 <input type="checkbox"/>	Not Available <input type="checkbox"/>	
Flexion (degrees)	Less than 70 <input type="checkbox"/>	70 to 90 <input type="checkbox"/>	91 to 110 <input type="checkbox"/>	Greater than 110 <input type="checkbox"/>	Not Available <input type="checkbox"/>

SURGICAL APPROACH					
Patient Procedure	Primary Total Prosthetic Replacement Using Cement			<input type="checkbox"/>	
	Primary Total Prosthetic Replacement Not Using Cement			<input type="checkbox"/>	
	Unicompartmental Knee Replacement (select all that apply)			<input type="checkbox"/>	
	Medial <input type="checkbox"/>	Lateral <input type="checkbox"/>	Patello-Femoral <input type="checkbox"/>		
	Primary Total Prosthetic Replacement Not Classified Elsewhere (e.g. Hybrid)			<input type="checkbox"/>	
Approach	Medial Parapatellar <input type="checkbox"/>	Mid-Vastus <input type="checkbox"/>			
	Lateral Parapatellar <input type="checkbox"/>	Other <input type="checkbox"/>			
	Sub-Vastus <input type="checkbox"/>				
Minimally Invasive Technique Used?	Yes <input type="checkbox"/>	No <input type="checkbox"/>			
Computer Guided Surgery Used?	Yes <input type="checkbox"/>	No <input type="checkbox"/>			
Robotic Surgery Used?	Yes <input type="checkbox"/>	No <input type="checkbox"/>			
If Yes, Name of Robot					
Patient Specific Instruments?	Yes <input type="checkbox"/>	No <input type="checkbox"/>			

THROMBOPROPHYLAXIS REGIME (intention to treat)					
Chemical (In Hospital)	Aspirin	<input type="checkbox"/>	Direct Thrombin Inhibitor (e.g. Dabigatran)	<input type="checkbox"/>	
	LMWH	<input type="checkbox"/>	Factor Xa Inhibitor (e.g. Rivaroxaban/Apixaban)	<input type="checkbox"/>	
	Pentasaccharide (e.g. Fondaparinux)	<input type="checkbox"/>	Other	<input type="checkbox"/>	
	Warfarin	<input type="checkbox"/>	None	<input type="checkbox"/>	
Mechanical	Foot Pump	<input type="checkbox"/>	Other	<input type="checkbox"/>	
	Intermittent Calf Compression	<input type="checkbox"/>	None	<input type="checkbox"/>	
	TED Stockings	<input type="checkbox"/>			

BONE GRAFT USED					
Was Femoral Bone graft used?	Yes <input type="checkbox"/>	No <input type="checkbox"/>			
Femoral - Form	Structural <input type="checkbox"/>	Morsellised/chips <input type="checkbox"/>			
Femoral - Type	Autograft <input type="checkbox"/>	Allograft <input type="checkbox"/>	Synthetic <input type="checkbox"/>	Other <input type="checkbox"/>	
Was Tibial Bone graft used?	Yes <input type="checkbox"/>	No <input type="checkbox"/>			
Tibial - Form	Structural <input type="checkbox"/>	Morsellised/chips <input type="checkbox"/>			
Tibial - Type	Autograft <input type="checkbox"/>	Allograft <input type="checkbox"/>	Synthetic <input type="checkbox"/>	Other <input type="checkbox"/>	

SURGEON'S NOTES

INTRA-OPERATIVE EVENT

Untoward Intra-Operative Event	None	<input type="checkbox"/>	Ligament Injury	<input type="checkbox"/>
	Fracture	<input type="checkbox"/>	Other	<input type="checkbox"/>
	Patella Tendon Avulsion	<input type="checkbox"/>		

Minimum Dataset Form - COMPONENT LABELS

1. Please affix any component labels to this sheet and ensure any extra component label sheets are attached to the main Minimum Dataset Form.
2. Ensure all component details are provided, including cement.
3. The NJR DOES NOT record the following: wire, mesh, cables or surgical tools.

Femoral Component (or unicondylar femoral component)


Tibial Tray (or unicondylar tibial component)

Meniscal Component

Cement (if used)

Patella (if used) Needed in Patello-femoral replacement

Accessories

 National Joint Registry www.njrcentre.org.uk Working for patients, driving forward quality	MDS VERSION 7.0 Form: MDSv7.0 K2 v6.0 Knee Operation
<div style="font-size: 48pt; font-weight: bold; float: left; margin-right: 10px;">K2</div> <div style="clear: both;"></div> Knee Single Stage Revision Knee Stage 1 of 2 Stage Revision Knee Stage 2 of 2 Stage Revision Knee Conversion to Arthrodesis Knee Amputation Secondary resurfacing of patella Secondary/subsequent partial replacement (Unicompartmental or PFJR) Debridement and Implant Retention (DAIR)	Patient Addressograph
Important: Please tick relevant boxes. All component stickers should be affixed to the accompanying 'Minimum Dataset Form Component Labels Sheet'. Please ensure that all sheets are stapled together.	

All fields are Mandatory unless otherwise indicated

REMEMBER! MAKE A NOTE OF THE NJR REFERENCE NUMBER WHEN YOU ENTER THIS DATA	NJR REF:
---	----------

PATIENT DETAILS

NJR Patient Consent Obtained	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Not Recorded <input type="checkbox"/>
If 'Yes' or 'No' was selected for patient consent above, was consent provided by a consultee on behalf of the patient?	Yes <input type="checkbox"/>	No/Not Known <input type="checkbox"/>	This refers to NJR consent being provided by a third party on behalf of the patient, not the 'consent to operate' normally obtained by the consultant. If an 'NJR Patient Consultee Declaration Form' has not been completed, this section should be completed as 'No/Not Known'
Body Mass Index (enter either H&W OR BMI OR tick Not Available box)	Height (IN M) Weight (IN KG)	BMI	Not Available <input type="checkbox"/>

PATIENT IDENTIFIERS

Forename(s)			
Surname			
Gender	Male <input type="checkbox"/>	Female <input type="checkbox"/>	Not Known <input type="checkbox"/> Not Specified <input type="checkbox"/>
Date of Birth	DD/MM/YYYY		
Patient Postcode		Overseas Address <input type="checkbox"/>	
NHS Number OR National Patient Identifier (if available)			
Patient Hospital ID			
Patient email address (optional)			
Patient mobile phone number (optional)			

OPERATION DETAILS

Hospital			
Operation Date	DD/MM/YYYY		
Anaesthetic Types	General <input type="checkbox"/>	Regional – Nerve Block <input type="checkbox"/>	
	Regional - Epidural <input type="checkbox"/>	Regional – Spinal (Intrathecal) <input type="checkbox"/>	
Patient ASA Grade	1 <input type="checkbox"/>	2 <input type="checkbox"/>	3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/>
Operation Funding	NHS <input type="checkbox"/>	Independent <input type="checkbox"/>	

SURGEON DETAILS

Consultant in Charge	
Operating Surgeon	
Operating Surgeon Grade	Consultant <input type="checkbox"/> SPR/ST3-8 <input type="checkbox"/> F1-ST2 <input type="checkbox"/> Specialty Doctor/SAS <input type="checkbox"/> Other <input type="checkbox"/>
First Assistant Grade	Consultant <input type="checkbox"/> Other <input type="checkbox"/>

KNEE REVISION PROCEDURE DETAILS

Procedure Type	Single stage revision (includes modular exchange for indications other than infection) <input type="checkbox"/>	Stage 2 of 2 Stage Revision <input type="checkbox"/>
	Stage 1 of 2 Stage Revision <input type="checkbox"/>	Conversion to Arthrodesis <input type="checkbox"/> Amputation <input type="checkbox"/> Debridement And Implant Retention (DAIR) <input type="checkbox"/>
Revision of	Primary Total Arthroplasty <input type="checkbox"/>	Previous Revision Arthroplasty (excluding excision arthroplasty) <input type="checkbox"/>
Side	Left <input type="checkbox"/> Right <input type="checkbox"/>	
Indications For / Findings at Time of Revision (select all that apply)	Aseptic Loosening	Instability <input type="checkbox"/>
	Femur <input type="checkbox"/>	Wear of Polyethylene Component <input type="checkbox"/>
	Tibia <input type="checkbox"/>	Component Dissociation <input type="checkbox"/>
	Patella <input type="checkbox"/>	Unexplained Pain <input type="checkbox"/>
	Infection <input type="checkbox"/>	Malalignment <input type="checkbox"/>
	Dislocation / Subluxation <input type="checkbox"/>	Peri-Prosthetic Fracture <input type="checkbox"/>
	Lysis	Implant Fracture <input type="checkbox"/>
	Femur <input type="checkbox"/>	Stiffness <input type="checkbox"/>
	Tibia <input type="checkbox"/>	Progressive Arthritis Remaining Knee <input type="checkbox"/>
		Other <input type="checkbox"/>

PREVIOUS OPERATION DETAILS

Previous Operation Date OR Year	DD/MM/YYYY <input type="text"/> Please enter Date if known	Not Available <input type="checkbox"/>
Previous Operation Hospital		Not Available <input type="checkbox"/>

COMPONENTS REMOVED (Do not complete for Stage 2 of 2 Stage Revision)

Femoral Component Removed	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Tibial Component Removed	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Tibial Liner Removed	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Patella Removed	Yes <input type="checkbox"/>	No <input type="checkbox"/>

SURGICAL APPROACH (Used for Single Stage, Stage 2 of 2 Stage Revision & DAIR)

Patient Procedure	Revision Using Cement <input type="checkbox"/>	
	Revision Not Using Cement <input type="checkbox"/>	
	Secondary Resurfacing of Patella <input type="checkbox"/>	
	Partial Replacement Second Compartment of Knee (Uni or PFR) <input type="checkbox"/>	
	Debridement And Implant Retention (DAIR) with Modular Exchange <input type="checkbox"/>	
	Debridement And Implant Retention (DAIR) without Modular Exchange <input type="checkbox"/>	
	Modular Exchange for indications other than infection <input type="checkbox"/>	
	Revision Not Classified Elsewhere (e.g. Hybrid) <input type="checkbox"/>	
Approach	Medial Parapatellar <input type="checkbox"/>	Quadriceps Turn-Down <input type="checkbox"/>
	Lateral Parapatellar <input type="checkbox"/>	Tibial Tubercle Osteotomy <input type="checkbox"/>
	Sub-Vastus <input type="checkbox"/>	Other <input type="checkbox"/>
	Mid-Vastus <input type="checkbox"/>	
Patient Specific Instruments? (Not applicable for DAIR without modular exchange)	Yes <input type="checkbox"/> No <input type="checkbox"/>	

THROMBOPROPHYLAXIS REGIME (intention to treat)				
Chemical (In Hospital)	Aspirin	<input type="checkbox"/>	Direct Thrombin Inhibitor (e.g. Dabigatran)	<input type="checkbox"/>
	LMWH	<input type="checkbox"/>	Factor Xa Inhibitor (e.g. Rivaroxaban/Apixaban)	<input type="checkbox"/>
	Pentasaccharide (e.g. Fondaparinux)	<input type="checkbox"/>	Other	<input type="checkbox"/>
	Warfarin	<input type="checkbox"/>	None	<input type="checkbox"/>
Mechanical	Foot Pump	<input type="checkbox"/>	Other	<input type="checkbox"/>
	Intermittent Calf Compression	<input type="checkbox"/>	None	<input type="checkbox"/>
	TED Stockings	<input type="checkbox"/>		

BONE GRAFT USED (Not applicable for DAIR procedures, i.e. DAIR <u>with</u> or <u>without</u> modular exchange)				
Was Femoral Bone graft used?	Yes <input type="checkbox"/>	No <input type="checkbox"/>		
Femoral – Form	Structural <input type="checkbox"/>	Morsellised/chips <input type="checkbox"/>		
Femoral – Type	Autograft <input type="checkbox"/>	Allograft <input type="checkbox"/>	Synthetic <input type="checkbox"/>	Other <input type="checkbox"/>
Was Tibial Bone graft used?	Yes <input type="checkbox"/>	No <input type="checkbox"/>		
Tibial - Form	Structural <input type="checkbox"/>	Morsellised/chips <input type="checkbox"/>		
Tibial - Type	Autograft <input type="checkbox"/>	Allograft <input type="checkbox"/>	Synthetic <input type="checkbox"/>	Other <input type="checkbox"/>
SURGEON'S NOTES				

INTRA-OPERATIVE EVENT				
Untoward Intra-Operative Event	None	<input type="checkbox"/>	Ligament Injury	<input type="checkbox"/>
	Fracture	<input type="checkbox"/>	Other	<input type="checkbox"/>
	Patella Tendon Avulsion	<input type="checkbox"/>		

Minimum Dataset Form - COMPONENT LABELS

1. Please affix any component labels to this sheet and ensure any extra component label sheets are attached to the main Minimum Dataset Form.
2. Ensure all component details are provided, including cement.
3. The NJR DOES NOT record the following: wire, mesh, cables or surgical tools.

Femoral Component (or unicondylar femoral component)

Tibial Tray (or unicondylar tibial component)

Meniscal Component

Cement (if used)

Patella (if used) Needed in Patello-femoral replacement

Accessories

Annual report 2021

The Swedish Arthroplasty Register





Annual report 2021

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Ola Rolfson

We cannot be held liable for any errors that may occur in printing, information and/or data files. Publisher: Ola Rolfson.

ISSN 1654-5982

ISBN english pdf version 978-91-986612-1-7

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Glossary

Adverse event	An unexpected negative event, in this case, as a consequence of joint replacement surgery, for example an infection.
Ahlbäck classification	Radiological classification of knee osteoarthritis
ASA class	American Society of Anesthesiologist physical status classification: classification of patients regarding medical comorbidity. The higher the ASA class, the greater the degree of comorbidity.
Aseptic loosening	Loosening of prosthesis component(s) without proven infection.
Bilateral prosthesis	Prosthesis in both right and left hip/knee respectively.
Bipolar head	Composite femoral head used for hemiarthroplasty where a smaller head is fixated on the prosthesis cone, and a larger head is snapped on to the smaller head. The result is that movement can take place in two joints, one between the smaller and the larger head, and one between the larger head and the acetabulum.
BMI	Body mass index = weight/height ² .
Case-mix profile	Case-mix or distribution of patient characteristics at each unit respectively.
CE	Conformité Européenne (in free translation: European conformity).
Charnley class	Classification of comorbidity that mainly relates to mobility. Class A refers to unilateral hip/knee disease, class B refers to bilateral hip/knee disease, and class C refers to multiple joint disease or other medical conditions that affect the walking ability.
Closed reduction	Return body part or fracture to proper position without surgical incision.
Computer assisted surgery (CAS)	A surgical concept and set of methods that use computer technology for surgical planning and for guiding or performing surgical interventions.
Confidence Interval (CI)	An estimate of a calculated value's uncertainty indicating the lower and upper limit.
Consumption	Refers to the number of hip/knee replacements per 100,000 inhabitants regardless of where the surgery has been performed.
Custom made instruments	Instruments or saw blocks specially made for the patient based on MRI or CT.
Cox regression	Regression model used for investigating the effect of several variables upon the time a specified event takes to happen.
CPUA	Central Personal Data Controller
Cruciate retaining (CR)	Minimally stabilizing, posterior cruciate retaining type of prosthesis.
DAIR	Debridement, Antibiotics, Implant Retention; Surgical procedure in case of deep infection if the implant is stable, with the aim to retain the prosthesis by debridement, rinsing and administering antibiotics to heal the infection.
Dislocation	For hip prostheses, this means that the joint head jumps out of the center of the joint cup. For knee prostheses, this usually means that the patella jumps to the side, but it does occur also that the prosthetic components of the femur and lower leg separate from each other.
DMC	Dual Mobility Cup have two points of articulation, one between the shell and the polyethylene (external bearing) and one between the polyethylene and the femoral head.
Elective surgery	Planned surgery.

EQ-5D	A standardized instrument, questionnaire, to measure general health.
European standard population (ESP)	A theoretical population used to be able to compare information from different countries.
Fast track	Care concept based on accurate preoperative information, early mobilization and effective pain relief to minimize length of stay while maintain high quality of care.
HA	Hydroxyapatite
Hardinge approach	Direct lateral approach in supine position.
Hazard ratio (HR)	Ratio of the hazard rates corresponding to the conditions described by two levels of an explanatory variable in a survival analysis.
Hinged prosthesis	Knee prosthesis that only allow for flexion and extension through a fixed axis.
HKA (hip-knee-ankle) angle	A measure of lower limb alignment from x-ray, defined as the angle between the mechanical axes of the femur and the tibia.
HOOS	Hip dysfunction and Osteoarthritis Outcome Score. A standardized instrument, questionnaire, to measure knee-related pain, function and quality of life.
Hybrid prosthesis	Total hip prosthesis with uncemented cup and cemented stem or knee prosthesis with uncemented tibial plate and cemented femur.
ICD-10	The 10th edition of the International Statistical Classification of Diseases and Related Health Problems governed by World Health Organisation
Incidence	The number of events in a given population over a limited period of time.
ISAR	International Society of Arthroplasty Registries.
Kaplan-Meier	Statistical method for estimating the probability of not having experienced a specific event (eg. death or revision) at a certain given time.
Knee osteotomy	Re-angeling of the knee joint to unload the diseased/injured part of the knee. Joint preserving surgery.
KOOS	Knee injury and Osteoarthritis Outcome Score. A standardized instrument, questionnaire, to measure hip related pain, function and quality of life.
KVÅ	Swedish Classification system of surgical procedures based on the Nordic Medico-Statistical Committee (NOMESCO) classification of surgical procedures.
Lateral position	Side position during surgery.
Local infiltration analgesia (LIA)	A multimodal concept for postoperative local pain relief.
Likert	A scale where the responder's different attitudes are measured Likert scales usually have five levels, but seven levels also exist.
Linked knee implants	(Linked/Rotating hinge) Have a mechanical coupling between the femoral and tibial components allowing for flexion and extension as well as for a varying amount of rotation.
Logrank-test	Statistical method to compare the difference between two or several survival distributions (Kaplan-Meier) where the hypothesis is that the distributions are equal.
MDR	Medical Device Regulation. Regulation on medical devices within the EU.

Minimal invasive surgery (MIS)	This implies a (small) arthrotomy used to gain access to the joint without the patella having to be everted.
NARA	The Nordic Arthroplasty Register Association.
NOAK	Non vitamin-k Orala AntiKoagulantia
NPO	A national program for knowledge management.
One-stage surgery	An operation performed in one occation.
Osteoarthritis (OA)	Osteoarthritis is a joint disease that affects the entire joint. The division in primary and secondary osteoarthritis is questionable as osteoarthritis is a complex condition that can have many contributing factors.
Osteolysis	Loosening of bone tissue.
Osteosynthesis	Repair a fracture with, for example, plates, screws, nails or steel wire.
NPR (PAR)	The national patient register of the National Board of Health and Welfare.
Partial knee resurfacing implant (PRKA)	“Buttons” that only replace a part of a knee compartment.
Patello-femoral knee replacement (PF)	A replacement which resurfaces the patello-femoral compartment.
PPFF	Periprosthetic femoral fracture.
Posterior stabilized knee replacement (PS)	A type of stabilizing knee prosthesis that requires resection of the posterior cruciate ligament.
Prevalence	Refers to the proportion of individuals who suffer from a certain disease or having a certain condition.
Production	Refers to the number of total hip/knee replacements per 100,000 inhabitants regardless of where the patient being operated lives.
PROM	Patient-Reported Outcome Measure
p-value	Measure that indicate the probability that, for example, two mean values differ. Given that the hypothesis that two or more groups have the same mean is true, the p-value is the probability to have an outcome at least as extreme as the outcome that is actually observed.
Reoperation	Reoperation includes all kinds of surgical intervention that can be directly related to an inserted hip/knee arthroplasty irrespective of whether the prosthesis or one of its parts has been exchanged, removed or left untouched. For knee replacements this also includes mobilisation under anaesthesia.
Reverse hybride	Total hip prosthesis with cemented cup and uncemented stem or knee prosthesis with cemented tibial plate and uncemented femur.
Revision	Exchange, addition or extraction of one or more inserted prosthesis components (including arthrodesis and amputation).
Rheumatoid arthritis (RA)	Inflammatory joint disease.
Risk ratio (RR)	The probability that some event will be observed in one group relative to the probability that it will be observed in another group.
SD	Standard deviation.
Sequelae	Impairment after disease, injury or trauma.

SHAR	Swedish Hip Arthroplasty Register
SKAR	Swedish Knee Arthroplasty Register
SALAR (SKR)	Swedish Association of Local Authorities and Regions.
SOASP	Supported OsteoArthritis Self-management Programme. A structured way of conveying fist-line treatment for osteoarthritis, which means information and exercise.
Standard patient	Male or female 55–85 years with primary osteoarthritis, ASA class I–II and BMI less than 30 operated on with a primary hip replacement.
Stabilized knee prosthesis	The term stabilizing is used only for a group of TKA-type prostheses that use the shape of the femur and the tibial component to restrict movement in the varus/valgus and rotation.
Swedish Arthroplasty Register (SAR)	Merger of the Swedish Hip Arthroplasty Register and the Swedish Knee Arthroplasty Register.
THR	Total hip replacement
TKR	Total knee replacement
TKR revision models	TKRs that are mainly used for revision or severe primary cases.
Two-stage surgery	An operation performed in two occasions.
Unicompartmental knee replacement (UKR)	Provide only the medial or lateral femorotibial compartment (medial UKR and lateral UKR respectively).
Unilateral prosthesis	Prosthesis only in one hip/knee.
Unipolar head	Femoral head that is fixated to the prosthesis cone, which articulates against acetabulum.
Unit	Clinic
Vancouver classification	Classification system for periprosthetic fractures. Type A: Trochanteric fractures that do not affect the prosthesis. Type B: Fracture in direct proximity to the prosthesis, subdivided into B1 (good bone-anchoring), B2 (loosening of the prosthesis), and B3 (loosening of the prosthesis and/or osteolysis). Type C: Fracture distally of the prosthesis.
VAS	Visual analogue scale. A 100 mm long horizontal scale where the value for a condition is given. Instrument for self-assessment.
Watson-Jones surgical approach	A type of antero-lateral surgical approach.



This annual report, we hope,
is the beginning of a
new era for joint replacement
surgery in Sweden.

1. Introduction

It is with great pleasure we welcome the reader to the first annual report of the Swedish Arthroplasty Register. It is truly a special event that Sweden's two first quality registers have joined forces and created a common register for hip and knee replacement. Since the 1970s, we have contributed to quality improvements in health care and we have been international role models. We are convinced that the merge will lead to further joint efforts to strengthen the care even more so that the outcome for patients who undergo joint replacement in Sweden also in the future will be of international top-class.

The annual report 2021

There is a great deal of work behind the merger of the two registers, which has been enabled by contributions from the Swedish Association of Local Authorities and Regions and from the Swedish Orthopaedic Association. An important part of the merger has been to create a common annual report. During the work with the annual report, we have put much effort in presenting data from knee and hip replacements as uniformly as possible. We have tried to combine the best from the former Hip and Knee Arthroplasty Registers. Here are some examples of harmonized definitions and uniform ways of presenting data in the annual report:

- A reoperation pertains to all types of surgery that is carried out around a prosthesis joint. For knee replacements, this also includes mobilisation under anaesthesia. Revision is a special kind of reoperation where one or more prosthesis components are exchanged, removed or added.
- Risk of revision or reoperation is presented as cumulative revision rate (CRR). It is done with Kaplan-Meier survival statistics and is calculated by subtracting the Kaplan-Meier survival estimate from 100%. The cumulative rate can be interpreted from the patient's viewpoint: if I am alive at a certain point in time, what is then the risk that I have had to undergo a revision or a reoperation?
- Comparisons of implants are made by comparing all commonly used implants, within a certain family, with a reference implant. Here we have computed the odds ratio for a certain implant compared to the reference implant.
- Comparison of the risk for revision between different units is presented as relative risk compared with the national average. Furthermore, the units' "ranking" with 95% confidence interval for the ranking is shown.

Due to lack of space, we have not been able to present all the analyses that the Hip and Knee Arthroplasty Registers used to present in their respective annual reports earlier. Some graphs and tables are available in an appendix on the Swedish Arthroplasty Register's website. We have also been forced to cut down the number of in-depth analyses. The idea is that in-depth analyses will be presented on a continuous basis in newsletters and on the website in the future.

Gångbar

The website Gångbar (www.gangbar.se) addresses patients. Here all requisite information has been gathered for those who have undergone or are about to undergo a knee or hip replacement. The website is developed by the register to give aggregated information about joint replacements and the rehabilitation afterwards, and has proven to be very popular since it has tens of thousands of visitors each year.

Production during the Covid year 2020

The Swedish Arthroplasty Register's annual report 2021 contains information on operations that were carried out until the 31st of December 2020. Never has the knee and hip arthroplasty community witnessed such a dramatic decline of the number of operations as it did during the pandemic year of 2020 compared with 2019. Primary total hip replacements decreased by 23% during 2020 as compared to 2019 and for primary knee arthroplasty the decrease was 30% (figure 1.1 and 1.2). We fear that it will take Swedish healthcare several years to deal with the amassed need for joint replacement that has arisen in as a result of the pandemic. Also, revisions and other reoperations decreased during 2020. Most noticeable was the decrease for knee arthroplasty revisions, which decreased by 21% while hip revisions decreased by 15% (figure 1.3 and 1.4). Unfortunately, we cannot take pleasure in the fact that the number of reoperations decreased – the main part of the decrease is thought to be due to cancelled operations and lack of resources due to the pandemic.

Remarkable research production

Despite the pandemic year and an intense work with merging the registers, the research activity with data from the register has been very high. During 2020, nine doctoral students whose dissertation in part or wholly was based on data from what is now the Swedish Arthroplasty Register defended their theses. During the last five-year period, 134 research articles have been published from the Hip and Knee Arthroplasty Registers. It is especially pleasing that we have research collaborations with all medical faculties in Sweden and many international research collaborations.

Thank you to all co-workers

We hope that this annual report is the beginning of a new era for joint replacement in Sweden. From all directions – patients, orthopaedic surgeons and other care staff, representatives from the implant industry, health-care decision-makers, professional associations, researchers and more – we have been met with great encouragement and only positive comments regarding the merger. We are happy to receive comments and proposals on changes of the design of the report in the future.

A prerequisite for our activity to function is that units register and provide the required information. We appreciate all the engagement and work that contact secretaries and contact orthopaedic surgeons around the country put in. We look forward to a continued good collaboration. Many thanks for all contributions during the past year!

September 2021

The Registry Management

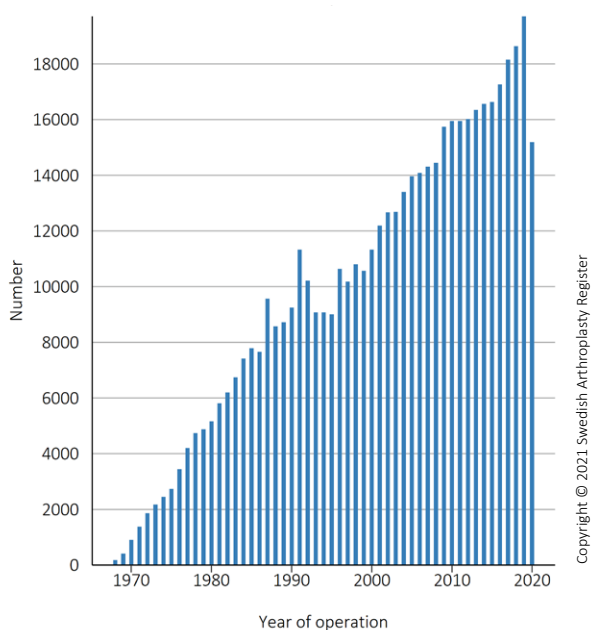


Figure 1.1. Primary total replacement surgery, hip.

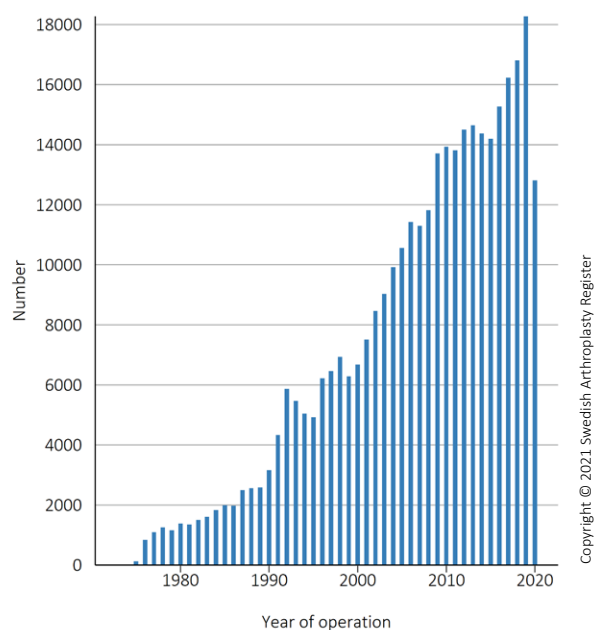


Figure 1.2. Primary knee replacement surgery.

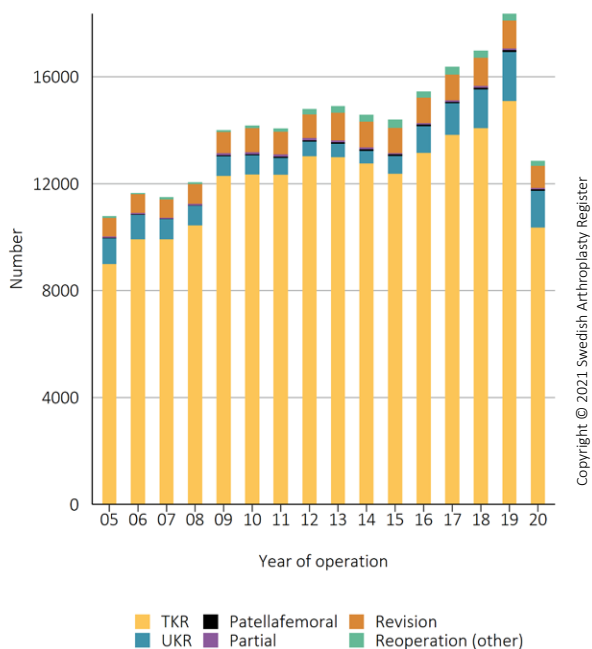


Figure 1.3. All knee replacements 2005–2020.

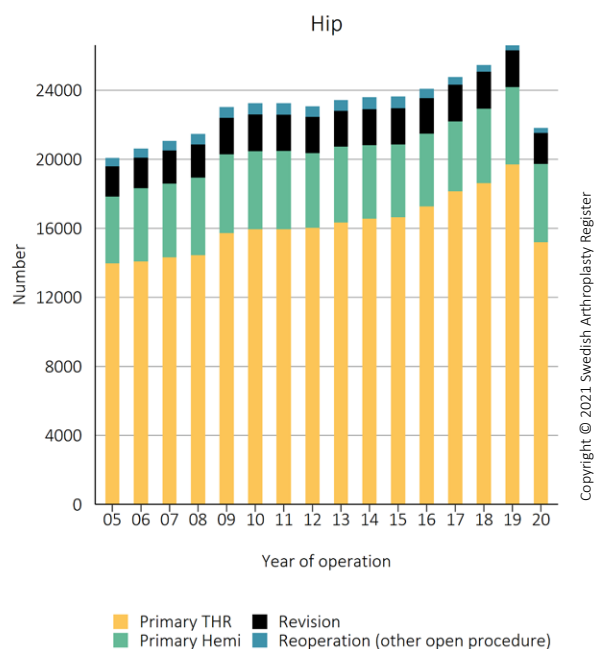


Figure 1.4. All hip replacements 2005–2020.

High completeness is important for the use of data in development activities, improvement work and research.

2. Data quality

Authors: Annette W-Dahl and Ola Rolfson

Completeness analysis

An important part of the validation work is the annual completeness analysis made in cooperation with the National Patient Register (NPR) of the National Board of Health and Welfare. By comparing the number of admissions and by assuming that the true number of admissions is the combined number in both registries the completeness can be estimated. The method is explained in table 2.1. The analysis comprises all primary operations, divided into total hip replacements, hemiarthroplasties, knee replacements, and hip and knee revisions. The National Patient Register contains Swedish personal identity numbers and temporary identity numbers while the Swedish Arthroplasty Register only contains personal identity numbers. Since there is a delay before the data

from the National Patient Register for operations performed previous year is complete, the completeness analysis is presented for operations performed in 2019. That data entered into quality registers and health data registers are correct is a prerequisite in order to be able to reassure that the results and analyses are of high quality and reliability and to enable better and fairer follow-ups. Of the operations that are registered in the Swedish Arthroplasty Register we can very likely say that they are hip or knee replacements. We also know which intervention has been reported since the registration among other things is based on the information from the stickers of the components during both primary operations and revisions. Further, medical records regarding reoperations are sent

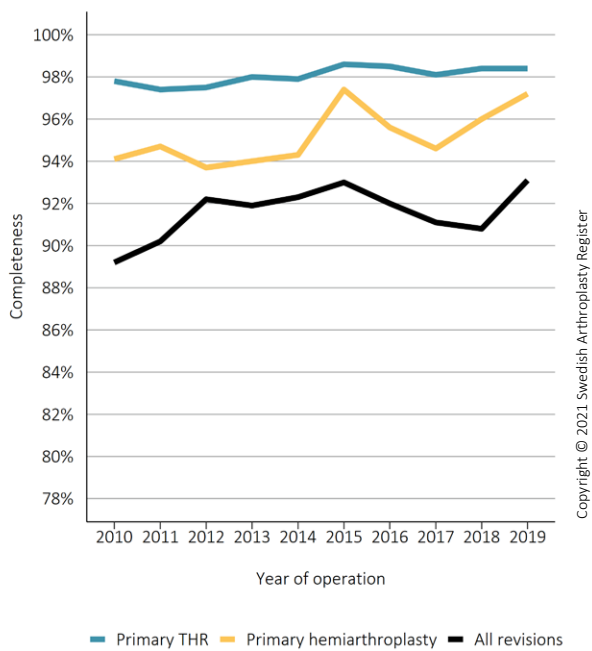


Figure 2.1a. Completeness for hip replacement 2010–2019.

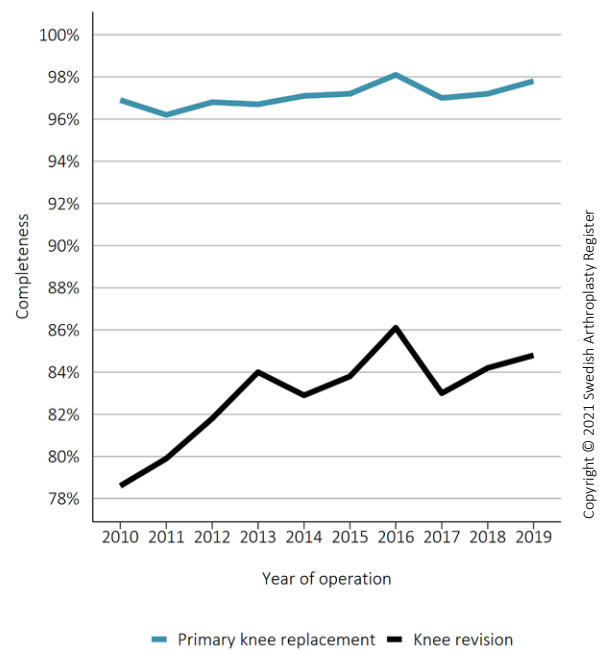


Figure 2.1b. Completeness for knee replacement 2010–2019.

to the register for review. On the other hand, units can fail to register operations both in the Swedish Arthroplasty Register and in the National Patient Register. An example of a source of error observed is when surgical codes for revision are reported to the National Patient Register when in fact it was not a revision but another reoperation. In those cases, the operation looks like a revision in the National Patient Register but not in the Swedish Arthroplasty Register.

To investigate trends in the reporting frequency, we present numbers for the last ten years (2010–2019). The completeness for total hip replacements has during this period been between 97 and 99% and in 2019 it was 98.4% (figure 2.1a). For hemiarthroplasties the completeness was 97.2% for 2019 and the reporting frequency has been between 94 and 97%. For knee replacements the completeness was 97.6% in 2019 and the reporting frequency has been between 97 and 98% (figure 2.1b).

The completeness for hip and knee revisions includes revisions, (removal, exchange or addition of any component). Codes according to the Classification of care measures (KVA codes) for revision surgeries are presented in table 2.1. The completeness for hip revisions has been presented for a couple of years while it is the first time for knee

revisions. From 2010 to 2019 the completeness for hip revisions has been between 89 and 93% and in 2019 it was 93.1% (figure 2.1). For knee revisions the completeness has varied between 79% and 86% during the period and in 2019 it was 84.8%.

Completeness analysis per unit

The completeness is presented for primary total hip replacements (table 2.2), hemiarthroplasties (table 2.3), knee replacements (table 2.4), and hip revision (table 2.5), and knee revision (table 2.6) per unit. Observe that the percentages for units with few operations can be misleading. Operations where the unit is not clear from the information from the National Board of Health and Welfare or as being performed at a specific hospital but by an administrative body containing several hospitals are reported in aggregate as “other units”. There are units not reporting to the National Patient Register but report to the Swedish Arthroplasty Register which means that a completeness analysis for these units is not possible. If the completeness is below 96% it is marked in red. For units with low completeness, we encourage local investigations to identify missing operations, coding routines for surgical procedures, in particular those involving revisions and other reoperations.

Response rate of variables and PROM questionnaires

The response rate in the Swedish Arthroplasty Register is presented in table 2.7 for the last five years (2016–2020) divided into type of primary operation. The response rate is almost complete or complete for most of the variables regardless of type of operation.

The PROM-programs for hip and knee replacements differ. PROM for hip replacements is followed up for the individual while operation is followed for the specific knee replacement (see chapter 8). For hip replacement patients, follow-up is sent out 1, 6 and 10 years after the latest surgical intervention. This implies that if a patient has contralateral or revision surgery, the timeline for follow-up

is reset at any new event. For knee replacements, every primary surgical intervention is followed-up one year postoperatively regardless if a contralateral or reoperation has taken place during the year of follow-up. Up to August 2021, the questionnaire for knee replacements includes 54 questions while the questionnaire for persons that are undergoing hip replacement surgery consists of 13 questions. Hip replacements have been followed since 2008 and knee replacements have been followed for operations in units that wanted and had the ability to collect PROMs since 2009 (approximately half of the knee replacements in 2019). In this year's report the response rate during the last four years is reported (table 2.8) and shows that the response rate has varied over the years and that there is room for improvement in the future.

Description of the completeness analysis

Completeness
<p>Primary hip replacements (total and hemi), primary knee replacements and hip and knee revisions in the Swedish Arthroplasty Register (SAR) are compared with corresponding in the National Patient register (NPR), in 2019. The completeness is calculated as a percentage of:</p> <p>Nominator All replacements/revisions in the SAR, performed during the current year.</p> <p>Denominator The total number of replacements/revisions either in the SAR or in the NPR, performed during the current year. A maximum of one procedure per individual and date has been included.</p>
Selection from the Swedish Arthroplasty Register
Hip and knee replacement surgeries and revisions of hip and knee replacements, performed during the current year.
Selection from the National Patient register
<p>Hip and knee replacements and revisions of hip and knee replacements registered in the NPR, inpatient care, performed during the current year. Registrations with procedure codes for each type of surgery were included;</p> <p>primary total hip replacements NFB29, NFB39, NFB49, NFB62 or NFB99 primary hemi hip replacements NFB09 or NFB19 primary knee replacements NGB09, NGB19, NGB39, NGB49, NGB53, NGB59 or NGB99 revisions of hip replacements NFC, NFU09 eller NFU19 revision of knee replacements NGC, NGU03, NGU09, NGU19 or NGU59</p> <p>Maximum one procedure per individual and date has been included.</p>
Matching criterion
Operations in the SAR were matched against the NPR by the unique personal identification number and procedure date +/- 7 days.
More about the processing
Information on the unit was obtained primarily from the SAR and secondary from the NPR. Only registrations with a Swedish personal identification number or temporary number were included in the sample selection from each register.

Table 2.1. Description of the completeness analysis.

Completeness for primary total hip replacement 2019

	Total number	SAR, %	NPR, %		Total number	SAR, %	NPR, %
Country	19,942	98.4	92.1	KS/Solna	83	67.5	97.6
Akademiska	187	97.3	97.3	Kullbergska sjukhuset	327	100	99.7
Aleris Specialistvård Bollnäs	272	98.9	97.4	Kungälv	211	100	99.5
Aleris Specialistvård Motala	147	89.8	99.3	Lidköping – Skövde	462	98.1	99.5
Aleris Specialistvård Nacka	265	99.2	95.8	Lindesberg	620	100	99.8
Aleris Specialistvård Ängelholm	437	99.8	95.7	Linköping	94	95.7	94.7
Alingsås	194	99.5	99.5	Ljungby	189	98.9	12.2
Art Clinic Göteborg	99	96.0	97.0	Lycksele	260	96.2	96.2
Art Clinic Jönköping	191	99.5	89.0	Mora	275	98.5	97.8
Arvika	233	98.3	98.7	Norrköping	255	99.6	98.8
Bollnäs	57	100	100	Norrtälje	193	98.4	99.0
Borås – Skene	377	97.1	98.1	Nyköping	167	98.8	98.2
Capio Artro Clinic	395	100	92.7	Oskarshamn	399	99.5	99.7
Capio Movement	327		0	Piteå	543	99.1	98.7
Capio Ortopedi Motala	332	99.1	98.8	Skellefteå	146	87.7	98.6
Capio Ortopediska Huset	690	99.4	99.0	Sollefteå	309	99.7	99.4
Capio S:t Göran	644	98.8	98.1	Sophiahemmet	272	98.2	87.1
Carlanderska	393		0	SU/Möndal	635	97.3	96.5
Danderyd	247	98.8	97.6	Sunderby sjukhus	53	98.1	96.2
Eksjö	242	100	99.6	Sundsvall	59	89.8	91.5
Enköping	424	99.5	98.8	SUS/Lund	113	98.2	98.2
Eskilstuna	98	100	98.0	SUS/Malmö	34	94.1	91.2
Falun	165	99.4	99.4	Södersjukhuset	334	98.5	98.8
Frölundaortopedien	12		0	Södertälje	200	98.5	99.0
GHP Ortho Center Göteborg	301	99.3	99.3	Torsby	114	100	100
GHP Ortho Center Stockholm	798	99.7	86.8	Trelleborg	680	100	99.7
Gällivare	104	100	99.0	Uddevalla – NÄL	418	99.5	99.3
Gävle	228	95.6	87.3	Umeå	138	97.8	97.8
Halmstad	234	100	98.7	Varberg	249	100	99.6
Helsingborg	50	96.0	96.0	Visby	159	95.0	95.6
Hermelinen	27		0	Värnamo	160	98.1	99.4
Hudiksvall	145	100	86.2	Västervik	161	98.8	98.1
Hässleholm	851	100	100	Västerås	582	96.4	97.9
Jönköping	197	100	99.0	Växjö	186	100	17.7
Kalmar	181	99.4	98.3	Ystad	10	0	100
Karlshamn – Karlskrona	356	99.2	98.3	Örebro	36	94.4	100
Karlskoga	18	100	100	Örnsköldsvik	157	98.1	98.7
Karlstad	159	99.4	98.7	Östersund	298	96.6	96.6
Kristianstad	27	70.4	92.6	Other units	18	27.8	72.2
KS/Huddinge	239	97.1	96.2				

Table 2.2. The completeness for primary total hip replacement per unit 2019.

Completeness for primary hemiarthroplasty hip 2019

	Total number	SAR, %	NPR, %
Country	4,602	97.2	94.0
Akademiska sjukhuset	134	99.3	95.5
Alingsås	45	100	100
Borås – Skene	97	97.9	91.8
Capio S:t Göran	152	97.4	96.1
Danderyd	227	97.4	96.9
Eksjö	36	97.2	100
Eskilstuna	78	100	98.7
Falun	101	98	92.1
Gällivare	38	100	100
Gävle	79	100	75.9
Halmstad	67	100	92.5
Helsingborg	188	97.3	96.3
Hudiksvall	48	100	93.8
Jönköping	40	92.5	97.5
Kalmar	79	100	94.9
Karlskrona – Karlskrona	116	99.1	95.7
Karlskoga	77	100	96.1
Karlstad	146	100	93.2
Kristianstad	124	97.6	89.5
KS/Huddinge	130	81.5	85.4
KS/Solna	34	70.6	70.6
Kungälv	68	98.5	100
Lindesberg	8	100	100
Lidköping – Skövde	108	97.2	95.4
Linköping	107	98.1	91.6
Ljungby	13	100	100

	Total number	SAR, %	NPR, %
Lycksele	32	100	65.6
Mora	56	89.3	83.9
Norrköping	70	100	95.7
Norrtälje	44	95.5	97.7
Nyköping	19	100	100
Skellefteå	49	98.0	95.9
SU/Möndal	306	97.1	94.8
Sunderby sjukhus	107	100	96.3
Sundsvall – Härnösand	95	90.5	89.5
SUS/Lund	160	100	95.0
SUS/Malmö	192	98.4	96.4
Södersjukhuset	247	97.6	98.8
Södertälje	16	93.8	100
Torsby	29	96.6	96.6
Uddevalla – NÄL	214	98.6	95.3
Umeå	66	100	97.0
Varberg	88	100	97.7
Visby	24	83.3	70.8
Värnamo	31	100	93.5
Västervik	50	100	92.0
Västerås	22	100	86.4
Växjö	66	95.5	93.9
Ystad	65	98.5	90.8
Örebro	60	91.7	93.3
Örnsköldsvik	76	96.1	97.4
Östersund	71	98.6	94.4
Other units	7	57.1	100

Table 2.3. The completeness for primary hip hemiarthroplasty per unit 2019.

Completeness for primary knee replacement 2019

	Total number	SAR, %	NPR, %
Country	17,041	97.6	90.9
Akademiska	92	92.4	97.8
Aleris Specialistvård Bollnäs	391	99.2	98.7
Aleris Specialistvård Motala	628	99.4	98.4
Aleris Specialistvård Nacka	207	99.0	95.7
Aleris Specialistvård Ängelholm	210	100	91.0
Alingsås	211	97.2	97.6
Art Clinic Göteborg	117	93.2	90.6
Art Clinic Jönköping	266	99.2	94.7
Arvika	252	99.2	99.6
Borås – Skene	294	96.9	98.0
Capio Artro Clinic/Sophiahemmet	655	98.5	85.9
Capio Movement	450	100	0.4
Capio Ortopedi Motala	8	0	100
Capio Ortopediska Huset	687	97.7	99.3
Capio S:t Göran	554	97.8	98.7
Carlanderska	427		0
Danderyd	171	97.1	99.4
Eksjö	329	99.7	99.7
Enköping	434	99.8	99.5
Eskilstuna	71	93.0	100
Falköping	38	100	97.4
Falun	180	99.4	100
GHP Ortho Center Göteborg	237	97.5	98.3
GHP Ortho Center Stockholm	712	97.9	92.7
Gällivare	104	100	97.1
Gävle	151	97.4	90.7
Halmstad	191	100	97.4
Helsingborg	21	90.5	95.2
Hermelinen	14		0
Hudiksvall	64	98.4	93.8
Hässleholm	765	99.1	99.5
Kalmar	116	96.6	99.1
Karlshamn	270	97.4	98.1
Karlskoga	1	100	100
Karlstad	118	94.9	94.9

	Total number	SAR, %	NPR, %
KS/Huddinge	195	92.8	97.9
KS/Solna	28	75.0	100
Kullbergsska sjukhuset	303	97.0	99.0
Kungälv	234	99.1	99.6
Lidköping – Skövde	263	98.9	98.5
Lindesberg	432	98.1	99.5
Ljungby	186	93.5	6.5
Lycksele	105	97.1	98.1
Mora	226	95.6	99.1
Norrköping	146	81.5	100
Norrtälje	201	97.5	99.4
Nyköping	152	100	97.4
Oskarshamn	401	99.0	99.0
Piteå	422	97.9	98.8
Skellefteå	122	97.5	99.2
Sollefteå	223	97.8	98.7
Specialistcenter Scandinavia	12		0
SU/Mölndal	434	93.1	98.7
Sundsvall	56	100	96.4
SUS/Lund	24	91.7	100
Södersjukhuset	229	96.5	99.6
Södertälje	157	98.7	98.7
Torsby	130	99.2	100
Trelleborg	779	98.8	99.1
Uddevalla	285	98.2	99.3
Umeå	169	89.3	95.3
Varberg	173	100	99.4
Visby	126	92.1	96.8
Värnamo	200	99.0	99.5
Västervik	108	98.1	100
Västerås	389	98.7	96.7
Växjö	99	98.0	7.1
Ängelholm	231	97.0	98.7
Örnsköldsvik	120	99.2	97.5
Östersund	213	97.7	99.1
Other units	32	0	100

Table 2.4. The completeness for primary knee replacement per unit 2019.

Completeness for hip revision 2019

	Total number	SAR, %	NPR, %
Country	2,329	93.1	89.4
Akademiska sjukhuset	134	96.3	91.0
Aleris Specialistvård Motala	6	100	100
Borås – Skene	68	97.1	94.1
Capio Ortopedi Motala	18	94.4	88.9
Capio S:t Göran	80	90.0	95
Danderyd	140	88.6	93.6
Eksjö	31	100	100
Eskilstuna	48	97.9	75.0
Falun	28	100	100
Gävle	69	98.6	79.7
Halmstad	32	100	78.1
Helsingborg	64	96.9	90.6
Hudiksvall	7	100	71.4
Hässleholm	89	97.8	97.8
Jönköping	30	90.0	86.7
Kalmar	20	100	85.0
Karlshamn – Karlskrona	42	90.5	95.2
Karlstad	57	98.2	93.0
Kristianstad	13	92.3	76.9
KS/Huddinge	91	93.4	93.4
KS/Solna	23	60.9	95.7
Kungälv	23	100	78.3
Lidköping – Skövde	82	97.6	74.4
Lindesberg	65	100	98.5
Linköping	46	89.1	80.4

	Total number	SAR, %	NPR, %
Ljungby	6	83.3	33.3
Mora	9	88.9	100
Norrköping	28	96.4	82.1
Norrtälje	17	94.1	88.2
Nyköping	10	90.0	100
Piteå	54	100	96.3
Skellefteå	8	87.5	100
SU/Mölndal	175	92.6	89.1
Sundsvall	20	95.0	50.0
Sunderby sjukhus	23	17.4	100
SUS/Lund	134	95.5	95.5
SUS/Malmö	6	33.3	100
Södersjukhuset	66	98.5	93.9
Trelleborg	12	100	100
Uddevalla – NÄL	57	98.2	96.5
Umeå	88	92.0	93.2
Varberg	18	100	8.3
Visby	17	76.5	82.4
Värnamo	13	92.3	69.2
Västervik	23	95.7	100
Västerås	89	80.9	93.3
Växjö	33	97.0	57.6
Örebro	7	100	85.7
Östersund	74	97.3	79.7
Other units	36	77.8	75.0

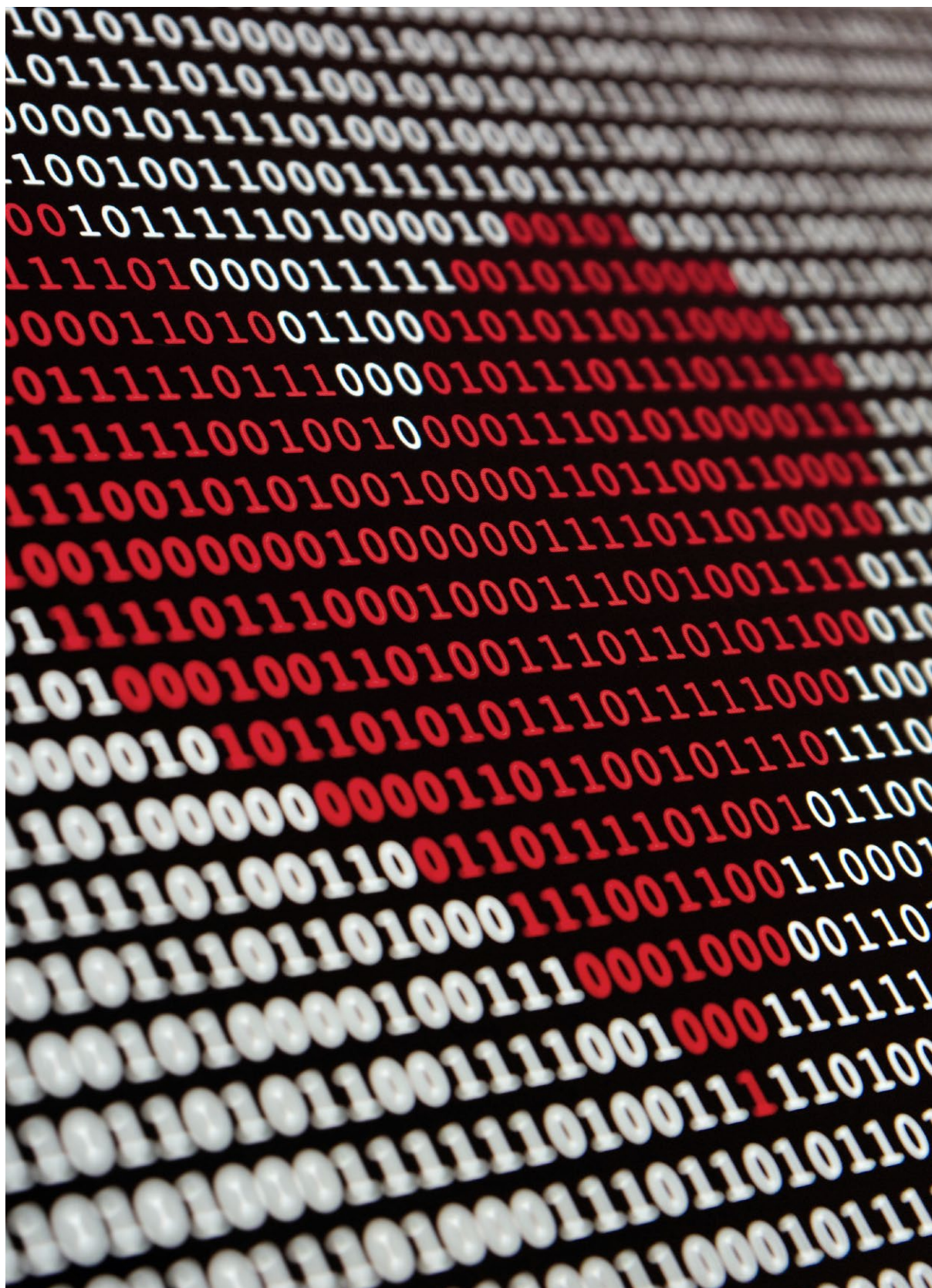
Table 2.5. The completeness for hip revision per unit 2019.

Completeness knee revision 2019

	Total number	SAR, %	NPR, %
Country	1,227	84.8	89.5
Akademiska	40	100	90.0
Aleris Specialistvård Bollnäs	12	100	91.7
Aleris Specialistvård Motala	44	90.9	100
Borås	22	100	63.6
Capio Arthro Clinic/Sophiahemmet	8	100	75.0
Capio Ortopediska Huset	25	68.0	76.0
Capio S:t Göran	54	66.7	87.0
Danderyd	41	87.8	78.0
Eksjö	34	88.2	100
Eskilstuna	31	83.9	87.1
Falun	25	100.0	72.0
GHP Ortho Center Stockholm	11	90.9	72.7
Gävle	18	100	66.7
Halmstad	8	100	100
Hässleholm	111	90.1	95.5
Kalmar	6	100	66.7
Karlshamn	10	100	90.0
Karlstad	15	86.7	80.0
KS/Huddinge	23	78.3	91.3
KS/Solna	17	76.5	94.1
Kullbergsska sjukhuset	7	49.2	100
Kungälv	19	89.5	94.7
Lidköping	19	100	94.7

	Total number	SAR, %	NPR, %
Lindesberg	31	93.5	90.3
Ljungby	11	90.9	18.2
Lycksele	7	42.9	100
Norrköping	10	80.0	90.0
Norrtälje	10	40.0	100
Nyköping	6	66.7	83.3
Oskarshamn	19	100	89.5
Piteå	19	89.5	100
Skene	10	0.0	100
Skövde	20	100	85.0
SU/Mölndal	101	88.1	92.1
Sundsvall	12	100	91.7
SUS/Lund	59	96.6	94.9
Södersjukhuset	56	75.0	98.2
Trelleborg	8	100	100
Uddevalla	19	94.7	94.7
Umeå	78	56.4	98.7
Varberg	13	100	76.9
Visby	14	78.6	92.9
Västervik	14	92.9	92.9
Västerås	17	100	94.1
Växjö	11	90.9	72.7
Östersund	23	91.3	87.0
Other units	59	74.6	83.1

Table 2.6. The completeness for knee revision per unit 2019.



Variables, response rate 2016–2020

	2016	2017	2018	2019	2020
Available data for all elective total hip replacements					
Total number of replacements	15,168	15,998	16,382	17,515	13,129
Articulation, %	100	100	100	100	100
ASA, %	99	99	99	100	99
BMI, %	99	99	98	99	99
Fixation, %	100	98	100	100	100
Available data for all hip replacements due to fracture					
Total number of replacements	6,172	6,043	6,394	6,533	6,476
ASA, %	95	95	95	97	97
BMI, %	73	73	73	80	79
Dementia, %	63	90	87	84	85
Fixation, %	100	99	100	100	100
Available data for all knee replacements					
Total number of replacements	14,074	14,978	15,498	16,978	11,805
ASA, %	100	100	100	100	100
BMI, %	100	100	100	100	100
Diagnosis, %	100	100	100	100	100
Previous surgery in the index knee, %	99	98	97	99	97
Fixation, %	100	100	100	100	100
Bone transplantation, %	100	100	100	100	100
Navigation (CAS), %	100	100	100	100	100
Patient specific instrument, %	96	99	100	99	100
MIS, %	100	100	100	100	100
Drainage, %	100	100	100	100	100
Anesthesia, %	100	100	100	100	100
Tourniquet, %	100	100	100	100	100
LIA, %	100	100	100	100	100
Antithrombosis prophylaxis, %	100	100	100	100	100
Prophylactic antibiotics, %	100	100	100	100	100

Variables, response rate 2016–2020, cont.

	2016	2017	2018	2019	2020
Available data for all knee osteotomies					
Total number of osteotomies	200	173	162	175	76
ASA, %	97	97	100	100	100
BMI, %	98	97	100	99	99
Surgical time, %	97	99	97	100	100
Diagnosis, %	100	100	100	99	100
Preoperatively HKA-angle, %	96	97	100	99	99
Preoperative OA-grade %	99	99	99	99	100
Previous surgery in the index knee, %	96	98	99	100	100
Bone transplantation, %	99	99	100	97	100
Navigation (CAS) %	98	99	100	100	100
Guiding instrument %	98	99	99	99	100
Drainage, %	98	99	100	99	100
Coincidental surgery, %	97	96	96	97	99
Anesthesia, %	100	97	99	99	100
Blodtomt fält %	98	99	99	99	100
Tourniquet, %	99	99	100	100	100
Prophylactic antibiotics, %	98	97	97	97	100
Implant %	100	98	100	100	99

Table 2.7. Variables, response rate 2016–2020.

PROM, response rate

Surgical year	2016	2017	2018	2019
Available data for all elective total hip replacements				
Total number of replacements	15,168	15,998	16,382	17,515
Diceased within one year (as first event), n	132	123	118	141
Reopererated within one year (as first event), n	276	275	314	296
Included in the one-year follow-up, n	14,760	15,600	15,950	17,078
Preoperative response, n	12,512	13,033	13,561	14,116
Proportion of all, %	83	82	83	81
One-year postoperative response, n	12,825	13,252	13,113	13,576
Proportion of those included in the follow-up routine, %	87	85	82	80
Pre- and one-year postoperative resopnde, n	10,673	10,826	10,898	11,010
Proportion of those included in the follow-up routine, %	72	69	68	65
Available data for all elective total hip replacements – OA				
Total number of replacements	13,999	14,769	15,112	16,085
Diceased within one year (as first event), n	104	95	97	114
Reopererated within one year (as first event), n	239	248	266	260
Included in the one-year follow-up, n	13,656	14,426	14,749	15,711
Preoperative response, n	11,680	12,154	12,656	13,111
Proportion of all, %	83	82	84	82
One-year postoperative response, n	11,947	12,321	12,197	12,579
Proportion of those included in the follow-up routine, %	88	85	83	80
Pre- and one-year postoperative resopnde, n	10,029	10,133	10,228	10,278
Proportion of those included in the follow-up routine, %	73	70	69	65
Available data for all knee replacements				
Total number of replacements for units included in the PROM project	5,574	6,455	7,655	8,160
Diceased within one year (as first event), n	38	36	34	35
Included in the one-year follow-up, n	5,536	6,419	7,621	8,125
Preoperative response, n	4,650	5,234	6,290	7,263
Proportion of all, %	84	82	83	89
One-year postoperative response, n	4,382	4,936	5,857	6,849
Proportion of those included in the follow-up routine, %	79	77	77	84
Pre- and one-year postoperative resopnde, n	3,907	4,258	5,109	6,120
Proportion of those included in the follow-up routine, %	71	66	67	75

PROM, response rate, cont.

Surgical year	2016	2017	2018	2019
Available data for total knee replacements – OA				
Total number of replacements for units included in the PROM project	4,805	5,732	6,723	7,033
Diceased within one year (as first event), n	34	33	28	29
Included in the one year follow-up, n	4,771	5,699	6,695	7,004
Preoperative response, n	4,077	4,782	5,570	6,320
Proportion of all, %	85	84	83	90
One-year postoperative response, n	3,801	4,525	5,164	5,923
Proportion of those included in the follow-up routine, %	80	79	77	85
Preoperative and one year postoperative response, n	3,433	3,907	4,552	5,352
Proportion of those included in the follow-up routine, %	72	69	68	76
Available data in unicompartmental knee replacements – OA				
Total number of replacements for units included in the PROM project	467	482	635	849
Diceased within one year (as first event), n	1	0	1	2
Included in the one year follow-up, n	466	482	634	847
Preoperative response, n	382	396	510	712
Proportion of all, %	82	82	80	84
One-year postoperative response, n	360	353	490	701
Proportion of those included in the follow-up routine, %	77	73	77	83
Pre- and one-year postoperative response, n	315	302	406	582
Proportion of those included in the follow-up routine, %	68	63	64	69

Table. 2.8 PROM, response rate 2016–2019.

Demography (from Greek demos – people and gráfo – writing) is the science of the distribution, size and composition of a population.



3. Demography

Authors: Annette W-Dahl and Ola Rolfson

All hip and knee replacements

During 2020, 19,718 primary hip replacements (total and hemi), 11,806 primary knee replacements and 1,749 hip revisions and 798 knee revisions were reported.

Sex

Women have more often primary hip or knee replacement surgery than men. The proportion of women having a primary hip replacement has decreased slightly since the millennium when the proportion of women was just over 61% to just under 58% in 2020 (figure 3.1a). In primary knee replacement surgery, the proportion of women has on the other hand decreased by about 10% since the millennium from 65% to 55% in 2020 (figure 3.1b). In hip revision, the proportion of men was higher while the proportion of women was higher in knee revisions (table 3.1).

Age

The mean age was 72.3 years for all primary hip replacements and 68.5 years for all primary knee replacements in 2020 (table 3.1). The mean age for men and women respectively has been almost unchanged from the beginning of the 2000s until 2020 in elective primary hip replacement surgery and has decreased with one and two years respectively in primary knee replacement surgery (figures 3.2 a-b). The same applies for the mean age in total knee replacement (TKR) (figure 3.3 a), while the mean age in unicompartmental knee replacement (UKR) has been stable in men but has decreased somewhat in women, from 68 years to 65 years (figure 3.3 b). The mean age for primary hip replacement surgery due to fracture was 73 years for men and 75.4 years for women 2003–2004. The mean age increased by approximately six years for both men and women in 2005 and has since, remained

unchanged (figure 3.4). The reason for the increase is that hemi hip replacements, which is a common treatment in fracture, started to be registered in 2005. Before 2005, only the fractures treated with a total hip replacement are included in the register. In hip revisions, the mean age was about three years lower than in primary elective hip replacement and in knee revisions, just over half a year higher than in primary knee replacement in 2020.

In primary elective hip replacement surgery there has been relatively small changes in the distribution in the age groups since 2005–2006 until 2020. It has increased slightly in the age group 65–74 years and decreased slightly in the age groups 55–64 years and 75–84 years (figure 3.5 a). In primary hip replacement surgery due to fracture, about 80% are 75 years or older. A smaller change has occurred since 2005–2006 in the older age group with an increase in the age group 75–84 years (figure 3.5 b). In both primary TKR and UKR the proportion of <65 years increased 2003–2014 but decreased thereafter. During the period 2001–2002 the proportion of <65 years who

underwent TKR was 23% and during the period 2019–2020 it was 29%. The corresponding figures for UKR was 44% and 43% respectively (figure 3.5 c-d).

BMI

The mean BMI in primary hip replacement surgery is lower (BMI 26.4) compared with primary knee replacement surgery (BMI 28.8) (table 3.1). The proportion who are defined as obese (BMI ≥ 30) according to the WHO classification is considerably higher in primary knee replacement (37.2%) than in primary hip replacement (20.5%) (table 3.1). In primary hip replacement surgery, women are overrepresented in the BMI class 25–29.9 (overweight) while the proportion of obese is about the same for men and women (figure 3.6 a). In primary knee replacement surgery, men on the other hand, are overrepresented in BMI class 25–29.9 (overweight) while the proportion of obese is higher for women than men (figure 3.6 b).

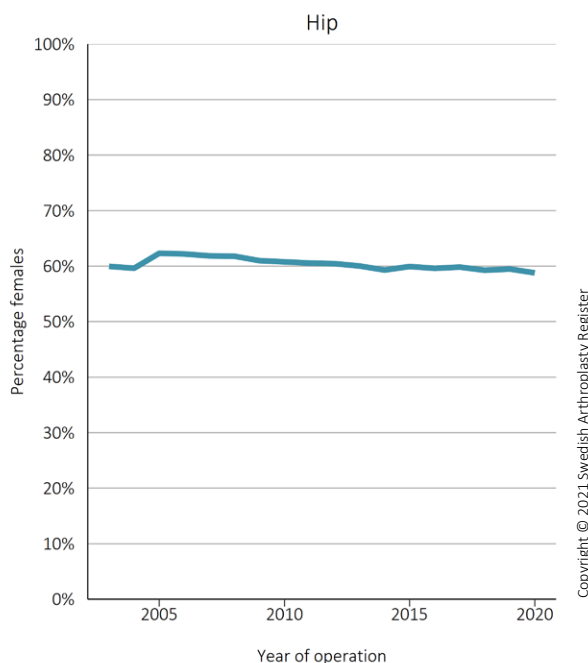


Figure 3.1a. Proportion of females with primary hip replacement 2003–2020.

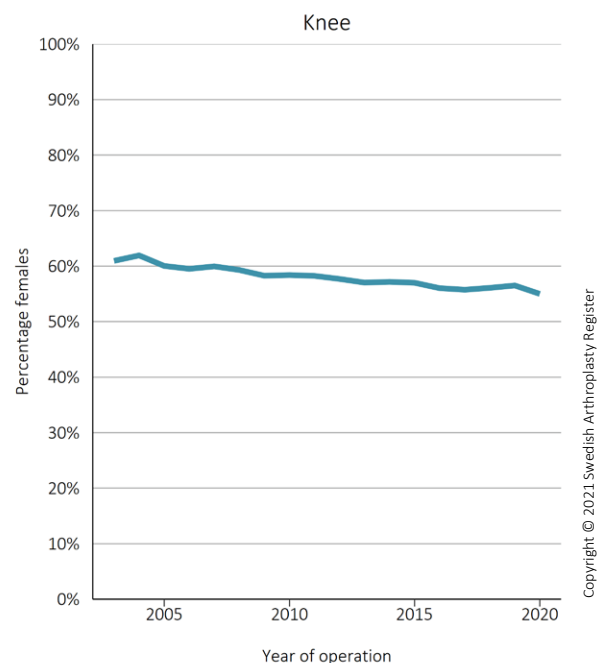


Figure 3.1b. Proportion of females with primary knee replacement 2003–2020.

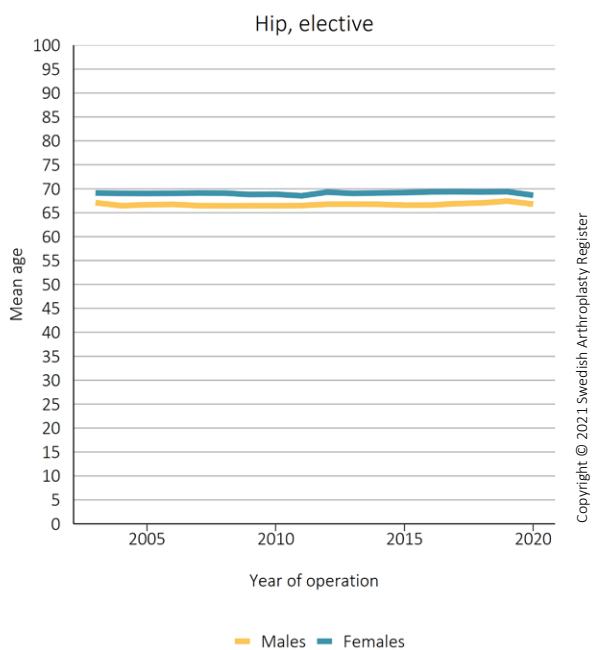


Figure 3.2a. Mean age in elective primary hip replacement 2003–2020.

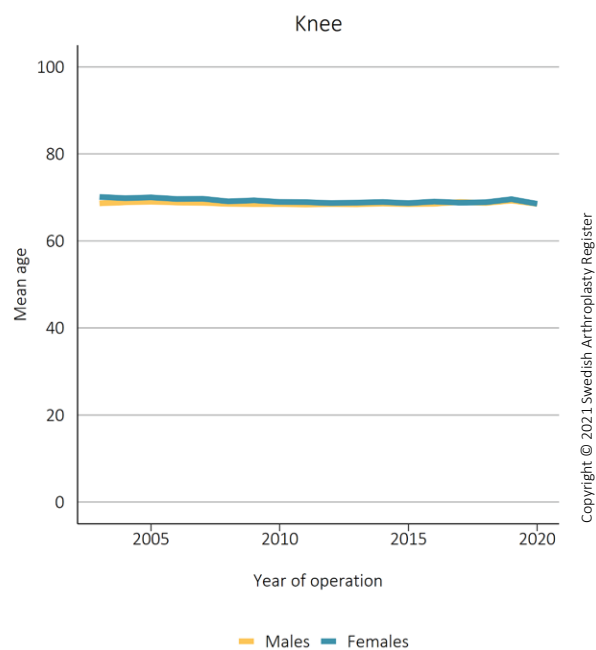


Figure 3.2b. Mean age in primary knee replacement 2003–2020.

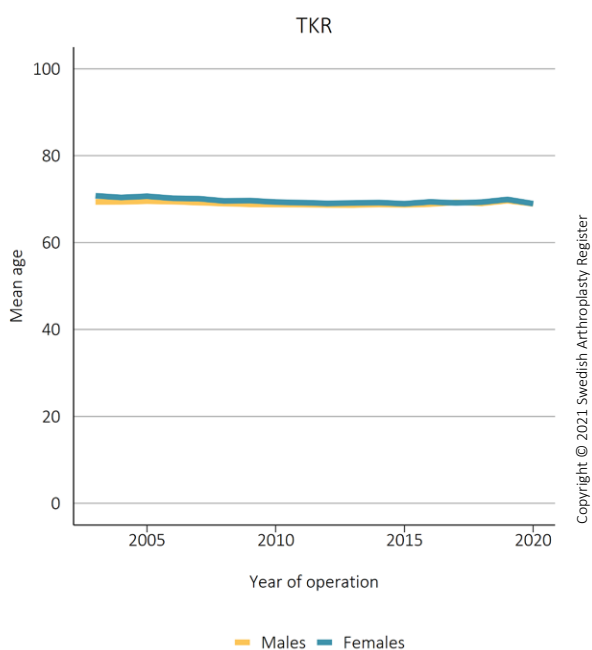


Figure 3.3a. Mean age in primary TKR 2003–2020.

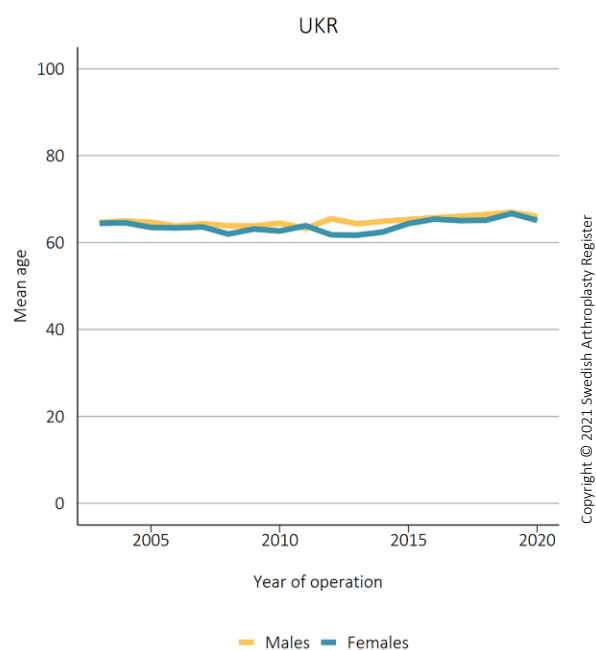


Figure 3.3b. Mean age in primary UKR 2003–2020.

ASA class

The proportion who are classified as ASA class III–IV in primary hip replacement surgery is almost twice (31.9%) that of the proportion who have the corresponding classification in primary knee replacement surgery (16.2%) (table 3.1). The higher proportion of ASA III–IV in primary hip replacement may be explained by that the hip fracture patients are included (see chapter 5.6). The proportion of ASA class III–IV is slightly higher in men than in women both in primary hip replacement and primary knee replacement (figure 3.7 a-b). In hip revisions the proportion of ASA III–IV is approximately equal to the proportion in primary surgery while it is almost twice as high in knee revisions as in primary surgery (table 3.1).

Diagnosis

Osteoarthritis is the absolute most common diagnosis in primary hip and knee replacement surgery (61% and 97% respectively). Osteoarthritis as indication for primary surgery is followed by acute hip fracture (31%) in hip replacement surgery and inflammatory joint disease (1.2%) in knee replacement surgery (table 3.1).

The proportion of those having primary hip replacement surgery due to osteoarthritis has increased slightly since 2005–2006 for women while remained stable for men. Osteoarthritis has increased from the period 2003–2004 to the period 2019–2020 in both women and men for primary knee replacement surgery (figures 3.8 a-b, 3.9 a-b).

The proportion of acute hip fracture as reason for primary hip replacement surgery has increased from 2005–2006 and is more common in women (30.2%) than men (17.4%) and have been largely unchanged until 2019–2020 for women (29.8%) but has increased for men (24.8%) (figures 3.8 a-b).

Inflammatory joint disease which includes rheumatoid arthritis has decreased as reason for primary hip and knee replacement surgery since the introduction of the disease-modifying anti-rheumatic drugs which is reflected by the lower proportion 2019–2020 as compared to 2003–2004 (figures 3.8 a-b, 3.9 a-b).

The proportion of acute hip fracture as reason for primary hip replacement surgery has increased during the last five years from 26.5% to 31% while the proportion of osteo-

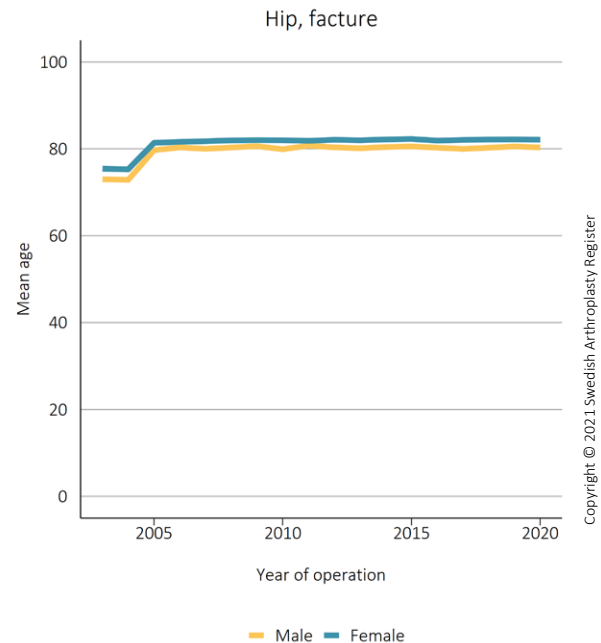


Figure 3.4. Mean age in primary hip replacement due to fracture 2003–2020.

arthritis has decreased from 65.2% in 2013 to 61.1% in 2020 (table 3.2). Osteoarthritis as reason for primary knee replacement surgery has remained largely unchanged the last five years (table 3.3).

Osteoarthritis as reason for primary hip replacement surgery decreases with increasing age from age group 55–64 years. The highest proportion is in the age group 55–64 years (86.3%) and the lowest in the age group ≥85 years (17.1%). Sequelae after childhood disease is most common in the youngest age group, <55 years. In acute hip fracture the relationship is reversed with a higher proportion with older age, the lowest proportion in the age group <55 years (1.7%) and the highest proportion in the age group ≥85 years (77.3%) (table 3.4).

For primary knee replacement surgery, the proportion of osteoarthritis as reason for surgery increases with increasing age while the proportion of inflammatory joint disease and sequelae fracture/trauma decreases with increasing age. Acute trauma as reason for primary knee replacement is uncommon, fewer than 60 operations (0.1%) were reported the last five years (table 3.5).

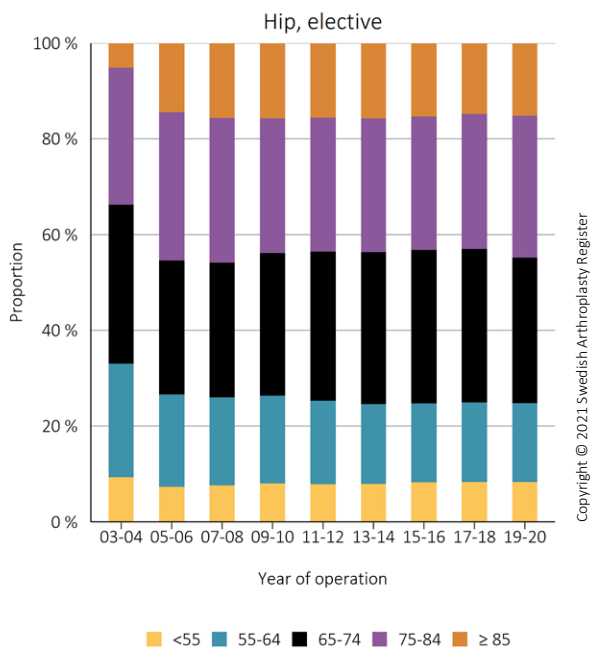


Figure 3.5a. Distribution in age groups in elective primary hip replacement 2003–2020.

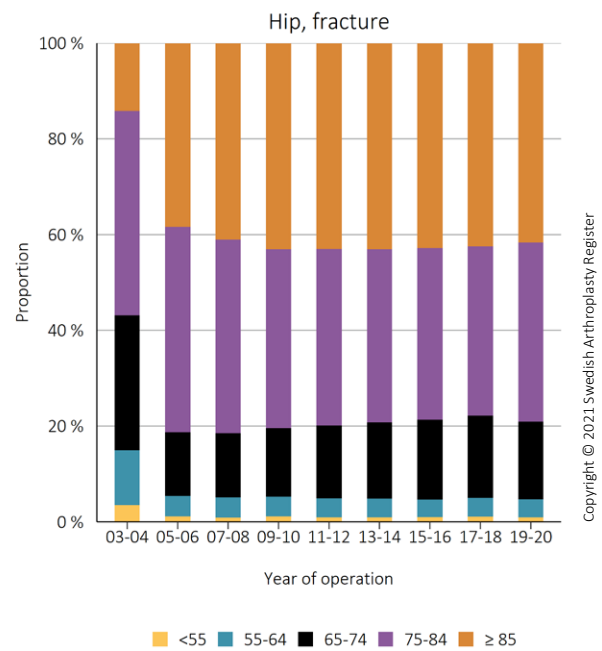


Figure 3.5b. Distribution in age groups in primary hip replacement due to fracture 2003–2020.

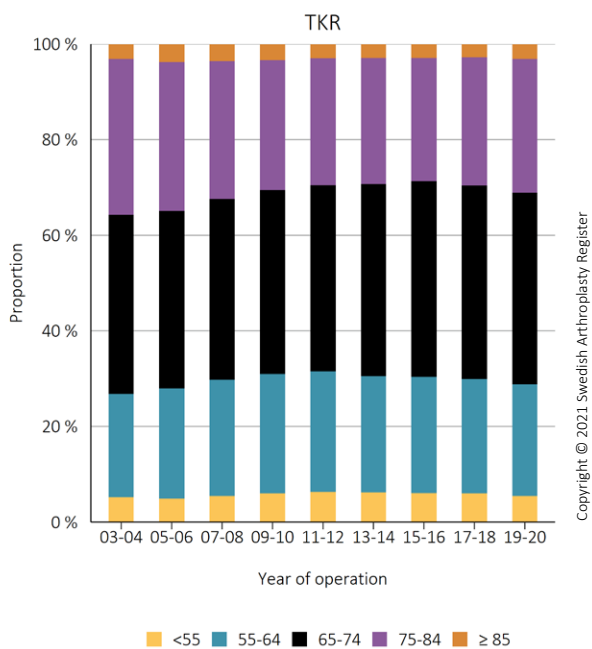


Figure 3.5c. Distribution in age groups in primary TKR 2003–2020.

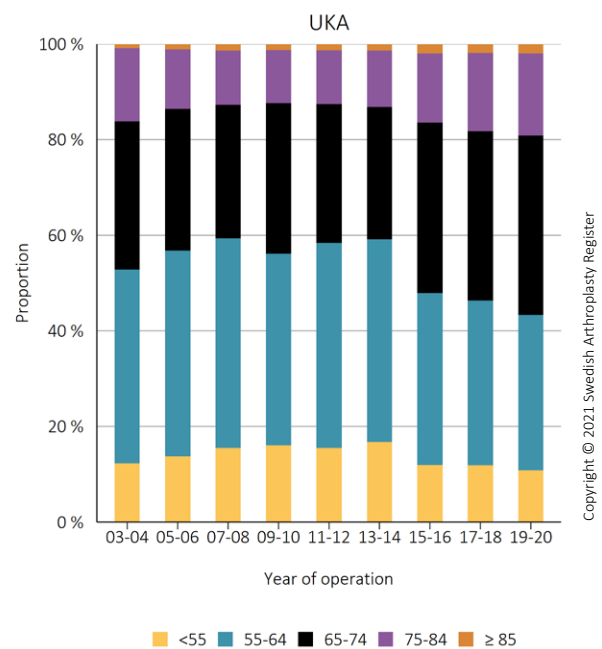


Figure 3.5d. Distribution in age groups in primary UKR 2003–2020.

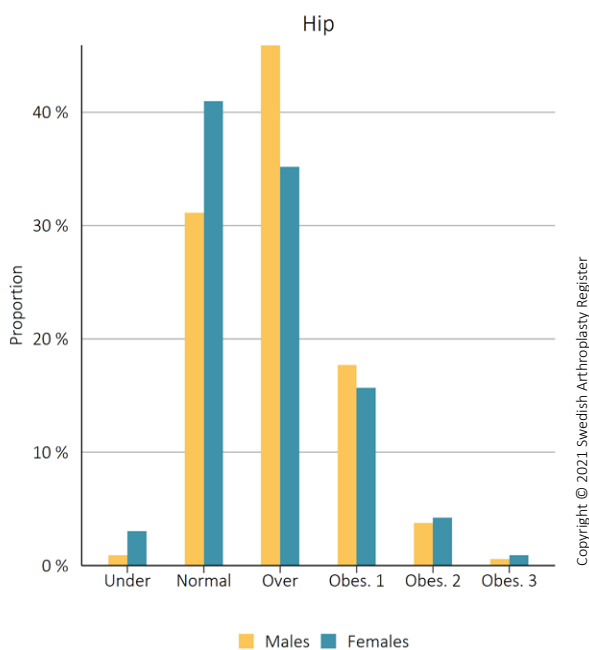


Figure 3.6a. Distribution in BMI class and sex in primary hip replacement.

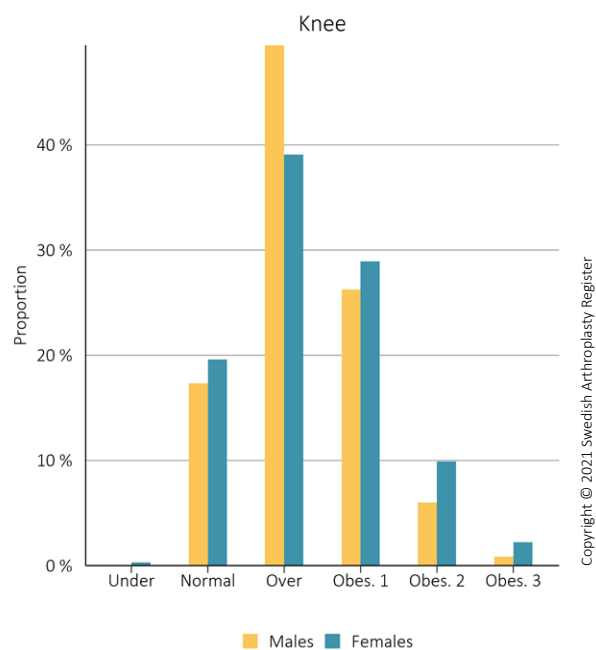


Figure 3.6b. Distribution in BMI class and sex in primary knee replacement.

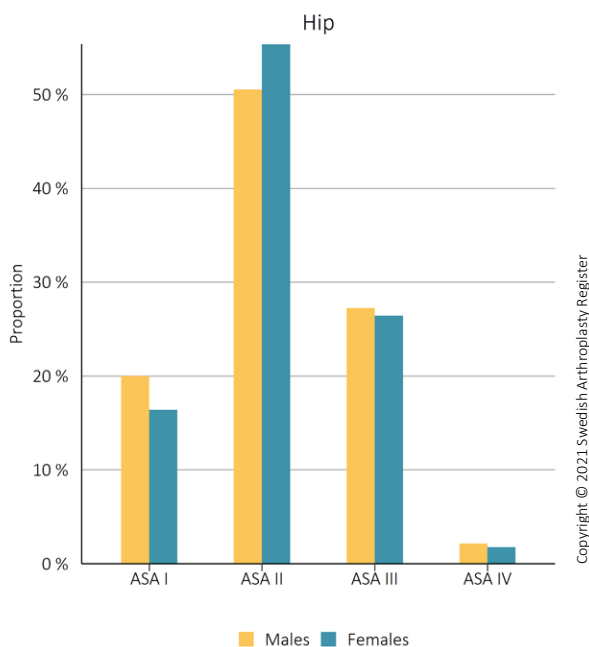


Figure 3.7a. Distribution in ASA class and sex in primary hip replacement.

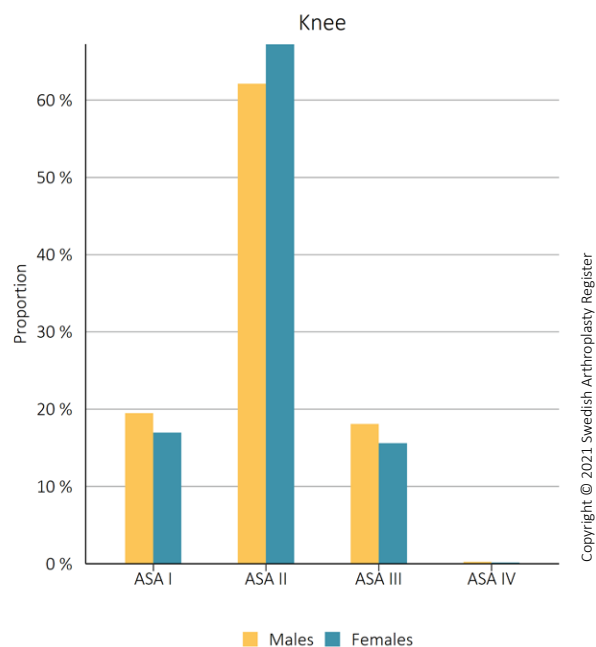


Figure 3.7b. Distribution in ASA class and sex in primary knee replacement.

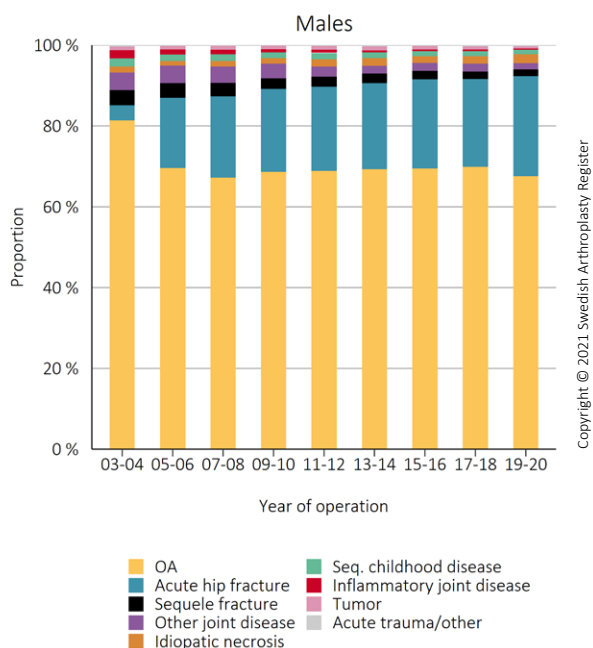


Figure 3.8a. Distribution of diagnosis in primary hip replacement – males.

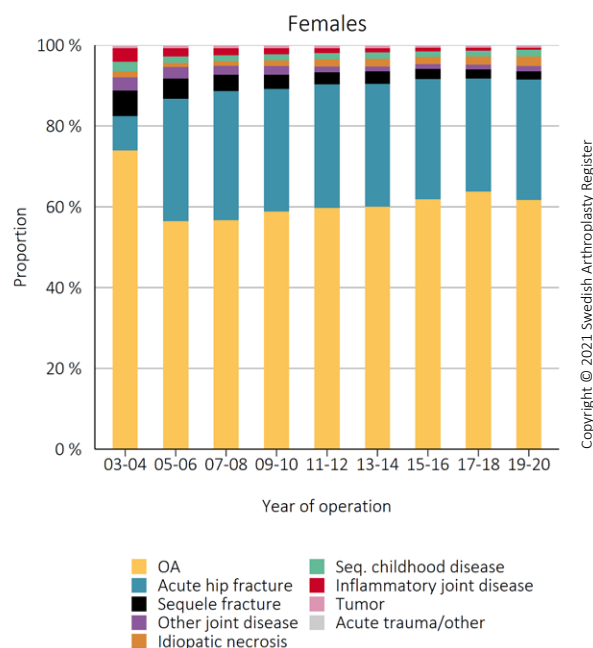


Figure 3.8b. Distribution of diagnosis in primary hip replacement – females.

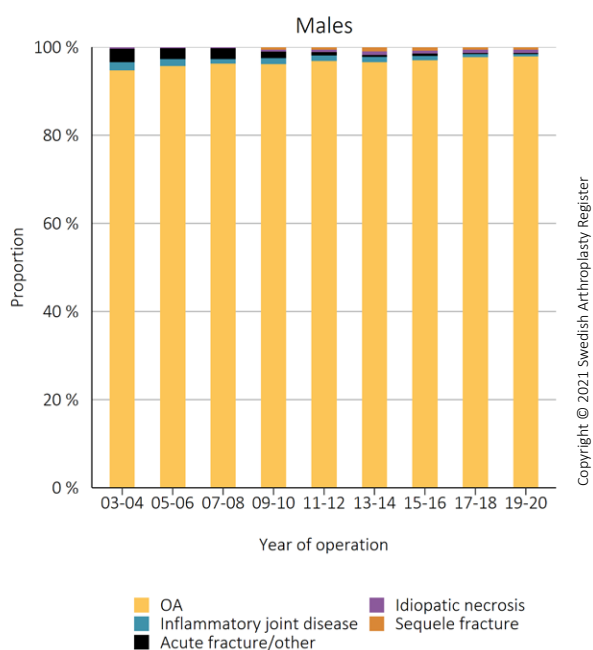


Figure 3.9a. Distribution of diagnosis in primary knee replacement – males.

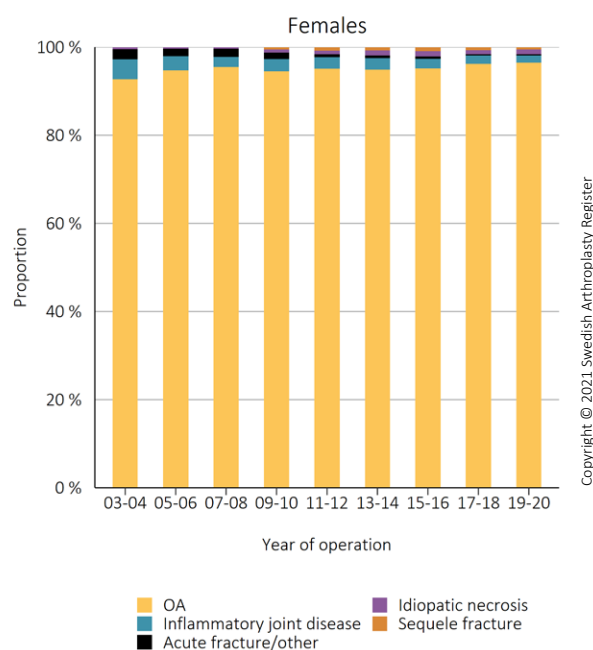


Figure 3.9b. Distribution of diagnosis in primary knee replacement – females.

Demography in hip and knee replacements 2020

	Primary hip	Revision hip	Primary knee	Revision knee
Number	19,718	1,749	11,806	798
Females (%)	11,590 (58.8)	854 (48.8)	6,492 (55.0)	417 (52.3)
Mean age (SD)	72.31 (12.20)	63.98 (13.41)	68.54 (9.14)	69.06 (9.49)
Age group (%)				
<55	1,652 (8.4)	385 (22.0)	809 (6.9)	56 (7.0)
55–64	3,352 (17.0)	530 (30.3)	3,116 (26.4)	198 (24.8)
65–74	5,731 (29.1)	463 (26.5)	4,529 (38.4)	300 (37.6)
75–84	5,808 (29.5)	254 (14.5)	3,037 (25.7)	213 (26.7)
≥ 85	3,175 (16.1)	117 (6.7)	315 (2.7)	31 (3.9)
BMI Mean(SD)	26.38 (4.56)	27.51 (5.18)	28.81 (4.29)	29.39 (4.67)
BMI (%)				
<18,5	438 (2.4)	23 (2.1)	20 (0.2)	2 (0.3)
18,5–24,9	7,040 (38.7)	339 (31.6)	2,227 (18.9)	119 (15.5)
25–29,9	6,952 (38.3)	389 (36.3)	5,151 (43.7)	327 (42.5)
30–34,9	2,949 (16.2)	229 (21.3)	3,393 (28.8)	231 (30.0)
35–39,9	692 (3.8)	76 (7.1)	873 (7.4)	75 (9.8)
≥40	98 (0.5)	17 (1.6)	123 (1.0)	15 (2.0)
ASA class (%)				
ASA I	3,056 (15.8)	214 (19.0)	2,053 (17.4)	72 (9.3)
ASA II	10,139 (52.3)	570 (50.5)	7,822 (66.3)	450 (58.0)
ASA III	5,696 (29.4)	333 (29.5)	1,901 (16.1)	245 (31.6)
ASA IV	481 (2.5)	11 (1.0)	15 (0.1)	9 (1.2)
Diagnosis (%)				
Osteoarthritis	12,049 (61.1)		11,451 (97.0)	
Acute hip fracture	6,103 (31.0)			
Sequele fracture/trauma	373 (1.9)		62 (0.5)	
Idiopathic necrosis	488 (2.5)		110 (0.9)	
Sequele childhood hip disease	256 (13)			
Inflammatory joint disease	73 (0.4)		142 (1.2)	
Tumor	103 (0.5)		7 (0.1)	
Acute trauma. other	37 (0.2)		15 (0.1)	
Other joint diseases	234 (1.2)		19 (0.2)	

Table 3.1. Demography in hip and knee replacement 2020.

Diagnosis in primary hip replacement

	2016	2017	2018	2019	2020	Total
Diagnosis, n (%)						
Osteoarthritis	14,011 (65.2)	14,773 (66.6)	15,115 (65.9)	16,087 (66.5)	12,049 (61.1)	72,035 (65.2)
Acute hip fracture	5,701 (26.5)	5,522 (24.9)	5,952 (25.9)	6,073 (25.1)	6,103 (31.0)	29,351 (26.6)
Sequele fracture/trauma	471 (2.2)	521 (2.3)	442 (1.9)	460 (1.9)	373 (1.9)	2,267 (2.1)
Idiopathic necrosis	392 (1.8)	425 (1.9)	450 (2.0)	539 (2.2)	488 (2.5)	2,294 (2.1)
Sequele childhood hip disease	281 (1.3)	290 (1.3)	328 (1.4)	376 (1.6)	256 (1.3)	1,531 (1.4)
Inflammatory joint disease	132 (0.6)	129 (0.6)	119 (0.5)	110 (0.5)	73 (0.4)	563 (0.5)
Tumor	131 (0.6)	136 (0.6)	146 (0.6)	128 (0.5)	103 (0.5)	644 (0.6)
Acute trauma, other	41 (0.2)	49 (0.2)	54 (0.2)	49 (0.2)	37 (0.2)	230 (0.2)
Other joint diseases	313 (1.5)	338 (1.5)	332 (1.4)	360 (1.5)	234 (1.2)	1,577 (1.4)
Total n	21,493	22,188	22,939	24,184	19,718	110,522

Table 3.2. Diagnosis in primary hip replacement 2016–2020.

Diagnosis in primary knee replacement

	2016	2017	2018	2019	2020	Total
Diagnosis, n (%)						
Osteoarthritis	13,525 (96.1)	14,523 (97.0)	14,991 (96.7)	16,491 (97.1)	11,451 (97.0)	70,981 (96.8)
Inflammatory joint disease	229 (1.6)	195 (1.3)	237 (1.5)	192 (1.1)	142 (1.2)	995 (1.4)
Idiopathic necrosis	133 (0.9)	133 (0.9)	136 (0.9)	148 (0.9)	110 (0.9)	660 (0.9)
Sequele fracture/trauma	120 (0.9)	89 (0.6)	106 (0.7)	107 (0.6)	62 (0.5)	484 (0.7)
Tumor	14 (0.1)	3 (0.0)	5 (0.0)	4 (0.0)	7 (0.1)	33 (0.0)
Acute trauma, other	16 (0.1)	6 (0.0)	9 (0.1)	11 (0.1)	15 (0.1)	57 (0.1)
Other joint diseases	37 (0.3)	29 (0.2)	14 (0.1)	24 (0.1)	19 (0.2)	123 (0.2)
Total n	14,074	14,978	15,498	16,977	11,806	73,333

Table 3.3. Diagnosis in primary knee replacement 2016–2020.

Diagnosis in age groups in primary hip replacement

	<55	55–64	65–74	75–84	≥85	Total
Diagnosis, n (%)						
Osteoarthritis	6,879 (74.7)	15,770 (86.3)	27,679 (79.6)	18,888 (59.5)	2,819 (17.1)	72,035 (65.2)
Acute hip fracture	152 (1.7)	882 (4.8)	4,773 (13.7)	10,772 (34.0)	12,772 (77.3)	29,351 (26.6)
Sequele fracture/trauma	175 (1.9)	307 (1.7)	554 (1.6)	707 (2.2)	524 (3.2)	2,267 (2.1)
Idiopathic necrosis	369 (4.0)	420 (2.3)	674 (1.9)	641 (2.0)	190 (1.1)	2,294 (2.1)
Sequele childhood hip disease	874 (9.5)	342 (1.9)	224 (0.6)	76 (0.2)	15 (0.1)	1,531 (1.4)
Inflammatory joint disease	135 (1.5)	130 (0.7)	198 (0.6)	88 (0.3)	12 (0.1)	563 (0.5)
Tumor	86 (0.9)	95 (0.5)	240 (0.7)	161 (0.5)	62 (0.4)	644 (0.6)
Acute trauma, other	10 (0.1)	26 (0.1)	52 (0.1)	88 (0.3)	54 (0.3)	230 (0.2)
Other joint diseases	526 (5.7)	291 (1.6)	380 (1.1)	300 (0.9)	80 (0.5)	1577 (1.4)
Total n	9,210	18,269	34,784	31,725	16,534	110,522

Table 3.4. Distribution of diagnosis by age group in primary hip replacement 2016–2020.

Diagnosis in age groups in primary knee replacement

	<55	55–64	65–74	75–84	≥85	Total
Diagnosis, n (%)						
Osteoarthritis	4,394 (93.5)	17,554 (96.8)	28,413 (97.1)	18,601 (97.1)	2,019 (96.1)	70,981 (96.8)
Inflammatory joint disease	145 (3.1)	228 (1.3)	358 (1.2)	248 (1.3)	16 (0.8)	995 (1.4)
Idiopathic necrosis	43 (0.9)	167 (0.9)	243 (0.8)	174 (0.9)	33 (1.6)	660 (0.9)
Sequele fracture/trauma	71 (1.5)	136 (0.8)	169 (0.6)	92 (0.5)	16 (0.8)	484 (0.7)
Tumor	20 (0.4)	4 (0.0)	4 (0.0)	5 (0.0)	0 (0.0)	33 (0.0)
Acute trauma, other	2 (0.0)	9 (0.0)	15 (0.1)	16 (0.1)	15 (0.7)	57 (0.1)
Other joint diseases	23 (0.5)	28 (0.2)	54 (0.2)	17 (0.1)	1 (0.0)	123 (0.2)
Total n	4,698	18,126	29,256	19,153	2,100	73,333

Table 3.5. Distribution of diagnosis by age group in primary knee replacement 2016–2020.



In the Swedish population,
1.8% have undergone at least one
hip replacement surgery and
1.4% a knee replacement surgery



4. Epidemiology

Authors: Annette W-Dahl and Ola Rolfson

4.1 Hip and knee replacement surgery in Sweden

Prevalence

When the number of persons who have a hip or a knee replacement are put in relation to the number of persons in the country it is referred to as the prevalence of persons with a hip or a knee replacement.

The calculation of the prevalence requires information about possible date of death. The persons having a total hip replacement after 1991 have been included, since the register started to register hip replacements on individual level in 1992. For knee replacements, the registration has been on individual level since the start of the register in 1975. Table 4.1 shows the number of persons in each age group and men and women in their age groups respectively with total hip or knee replacement, unilaterally or bilaterally operated. The corresponding numbers, but for persons who have undergone bilateral hip or knee replacement surgery are shown in table 4.2. The tables also show the prevalence per 100,000 inhabitants ≥ 45 years at the end of each year 2005–2020 in 5-year intervals.

At the end of 2020, 190,815 persons had undergone at least one total hip replacement surgery and 149,043 persons had undergone knee replacement surgery. This means that 1.8% of the population has at least one total hip

replacement and 1.4% at least one knee replacement. 28% of persons with a total hip replacement were operated bilaterally and 33% with a total knee replacement were operated bilaterally.

The prevalence is highest in the ages 65–84 years for both total hip and total knee replacement and the prevalence is higher for women than men.

Incidence

When the number of primary replacements performed in one year are put in relation to the number of inhabitants in the country this is referred as the country's incidence for the procedure. Observe that the incidence of hip and knee replacement is calculated based on the number of replacements while the prevalence is based on the number of persons. During 2020, 12,049 primary total hip replacements and 11,808 primary knee replacements were registered which gives the incidence 146 for total hip replacement and 114 for knee replacement. Due to the pandemic year 2020 the number of total hip replacements and knee replacements has decreased with 25% and 30 % respectively as compared to 2019 and thus the incidence is also lower.

The incidence has increased over the years for both hip and knee replacement. The strong increase of knee replacement seen since the late 1980s has weakened somewhat after 2009. For hip replacement the increase has also slowed down, and the incidence has been more or less constant. Since it is the elderly who mainly undergo hip and knee replacement surgery, a smaller proportion of the increase over time depends on the aging population.

Since the incidence depends on age and the age structure in different regions and countries may vary it is difficult to make comparisons without some form of age standardisation. The so-called “European Standard population” has been used to make comparisons possible. This standardisation describes what the incidence had been for a certain region/country if all regions/countries would have had the same age distribution.

In an international comparison Sweden has a higher incidence of hip replacement than the US, Australia and the UK but lower than Denmark, Norway, Finland and Germany. For knee replacement Sweden has a higher incidence than Norway but lower than Denmark, Finland, the US, Australia, the UK and Germany (OECD Health Statistics 2019).

Regional differences

According to the Healthcare Act (SFS 2017:30) the aim for the healthcare is “... a good health and equal conditions for the whole population. Care is to be provided with respect for the equal value of every person and for the dignity of each individual. Priority shall be given to the one who is in the greatest need of healthcare.”

An important aspect of equality are geographical differences in how healthcare is conducted and provided within the country. Equality may in a broad sense of the word be related to where in the country patients’ lives. The 21 regions have self-determination over their healthcare efforts but have to follow the Healthcare Act.

Production and consumption

Production and consumption are based on data from the Swedish Arthroplasty Register, the population statistics from Statistics Sweden and the address register from the Swedish Tax Agency. Production refers to the number of total hip replacements and knee replacements regardless of where the person having surgery lives, that is the region’s production and is presented per 100,000 inhabitants. Consumption refers to the number of total hip replace-

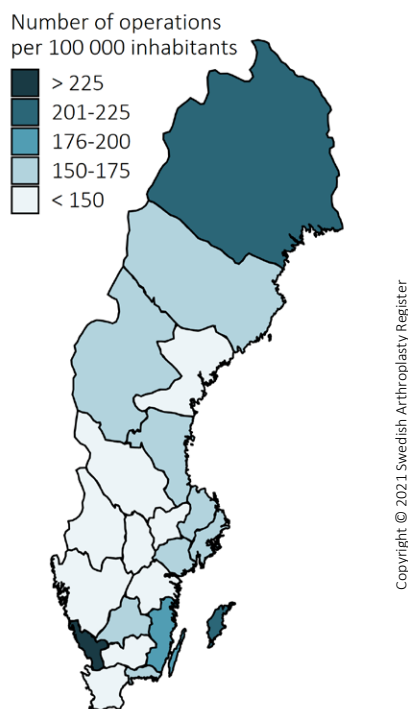


Figure 4.1a. Production total hip replacement.

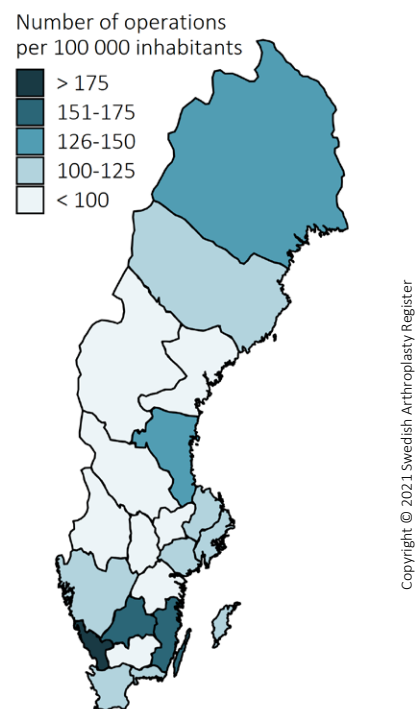


Figure 4.1b. Production knee replacement

ments and knee replacements irrespective of where the surgery is carried out and is presented per 100,000 inhabitants. Consumption thus entails that the inhabitants in the region have access to hip and knee replacement surgery independently if the surgery is carried out in their home region or somewhere else in the country. The consumption calculations are based on data from the Swedish Tax Agency on region affiliation when the surgery is carried out.

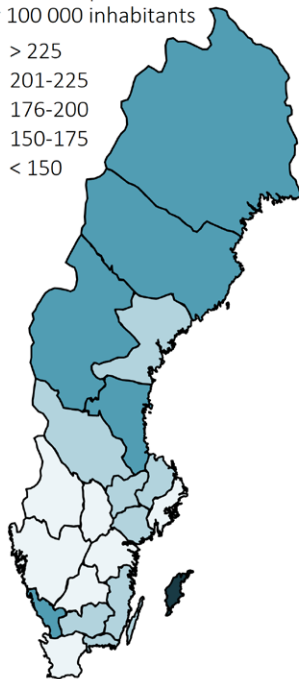
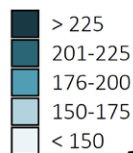
The Sweden maps show the distribution of production and consumption respectively for total hip replacement surgery (4.1 a and 4.2 a) and knee replacement surgery (4.1 b and 4.2 b) per 100,000 inhabitants in the 21 regions. The tables 4.3 and 4.4 show the production and consumption respectively with incidence and age standardised incidence (European Standard population) for total hip placement and knee replacement surgery in the regions.

Regarding production, the age standardised incidence varies from 90 to 224 for total hip replacement surgery and from 40 to 219 for knee replacement surgery. Halland has the highest production incidence for both hip and knee replacement while Dalarna has the lowest incidence for hip and Västmanland for knee. The production is more

than twice as high in Halland compared to Dalarna regarding total hip replacement surgery and more than five times as high in Halland compared to Västmanland for knee replacement surgery. The differences in age standardised incidence for consumption varies from 117 to 191 for total hip replacement surgery and from 76 to 152 for knee replacement surgery. For total hip replacement surgery Västmanland has the lowest consumption, less than half the incidence compared to Gotland that has the highest consumption. For knee replacement surgery, Halland with the highest incidence, has twice the consumption of Västmanland with the lowest consumption.

The differences in consumption are important considering the aim of the healthcare and the promise of equal care. Different effects of the pandemic in the regions may certainly have affected both production and consumption. The age standardised consumption has however, varied relatively widely between regions and in regions different years.

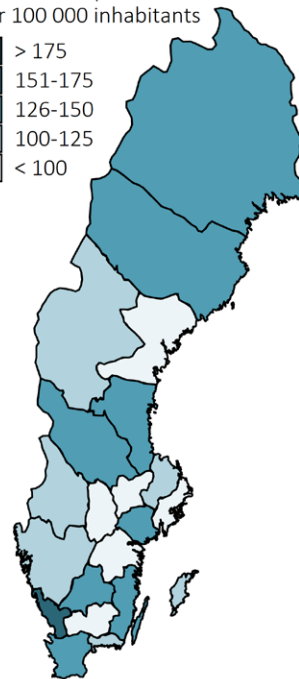
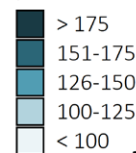
Number of operations
per 100 000 inhabitants



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Figure 4.2a. Consumption total hip replacement.

Number of operations
per 100 000 inhabitants



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Figure 4.2b. Consumption knee replacement.

Number of individuals with total hip replacement or knee replacement

Number per age group	Hip				Knee			
	2005	2010	2015	2020	2005	2010	2015	2020
<45	1,568	1,919	1,872	1,793	287	352	397	335
45–54	4,073	5,516	6,858	7,614	1,634	2,556	3,160	3,425
55–64	16,072	18,887	19,942	23,266	8,802	13,697	16,335	19,148
65–74	28,962	40,619	51,522	53,701	17,841	28,324	39,544	46,816
75–84	36,464	44,660	54,812	70,813	25,196	31,750	40,108	54,775
85 +	15,499	22,711	28,381	33,628	10,066	14,949	19,086	24,544
Total	102,638	134,312	163,387	190,815	63,826	91,628	11,863	14,9043
Prevalence per 100,000 >=45	2,570	3,190	3,677	4,078	1,616	2,199	2,691	3,209
Males								
<45	714	922	947	888	110	148	178	155
45–54	2,070	2,936	3,713	4,006	590	990	1,272	1,400
55–64	7,562	9,120	9,983	11,835	3,605	5,783	6,829	8,106
65–74	12,453	17,768	22,99	24,323	7,096	11,965	17,445	21,008
75–84	13,140	16,777	21,190	28,140	8,170	11,301	15,631	23
85 +	4,254	6,436	8,316	10,206	2,375	3,916	5,355	7,737
Total	40,193	53,959	67,139	79,398	21,946	34,103	46,710	61,406
Prevalence per 100 000 >=45	2,109	2,658	3,107	3,472	1,166	1,702	2,184	2,709
Females								
<45	854	997	925	905	177	204	219	180
45–54	2,003	2,580	3,145	3,608	1,044	1,566	1,888	2,025
55–64	8,510	9,767	9,959	11,431	5,197	7,914	9,506	11,042
65–74	16,509	22,851	28,532	29,378	10,745	16,359	22,099	25,808
75–84	23,324	27,883	33,622	42,673	17,026	20,449	24,477	31,775
85 +	11,245	16,275	20,065	23,422	7,691	11,033	13,731	16,807
Total	62,445	80,353	96,248	11,1417	41,880	57,525	71,920	8,7637
Prevalence per 100 000 >=45	2,989	3,683	4,213	4,656	2,024	2,66	3,169	3,685

Table 4.1. Number of individuals in each age group and males and females in each age group with total hip replacement or knee replacement, unilaterally or bilaterally operated.

Number of individuals with total hip replacement or knee replacement, bilaterally operated

Number per age group	Hip				Knee			
	2005	2010	2015	2020	2005	2010	2015	2020
<45	332	400	396	335	72	64	61	43
45–54	716	1,085	1,468	1,676	309	495	618	665
55–64	3,230	4,216	4,686	5,870	2,016	3,383	4,400	5,259
65–74	6,112	10,099	13,661	14,632	4,787	8,156	12,263	15,594
75–84	6,342	10,293	15,116	20,755	7,187	9,929	13,741	19,314
85 +	2,056	4,247	6,555	9,419	2,767	4,499	6,289	8,559
Total	18,788	30,340	41,882	52,687	17,138	26,526	37,372	49,434
Prevalence per 100 000 ≥ 45	469	721	944	1,130	434	638	849	1,066

Table 4.2. Number of individuals in each age group and males and females in each age group with total hip replacement or knee replacement, bilaterally operated.



Production in the regions


Region	Hip		Knee	
	Incidence	Age standardized incidence	Incidence	Age standardized incidence
Country	146	146	114	114
Stockholm	151	176	120	141
Uppsala	150	160	100	108
Södermanland	155	141	119	109
Östergötland	120	118	92	90
Jönköping	151	149	159	158
Kronoberg	130	127	66	64
Kalmar	193	163	155	129
Gotland	223	180	106	86
Blekinge	160	141	109	95
Skåne	117	119	116	120
Halland	239	224	233	219
Västra Götaland	136	139	102	105
Värmland	112	97	91	78
Örebro	141	135	89	84
Västmanland	141	127	43	40
Dalarna	108	90	78	66
Gävleborg	171	146	128	113
Västernorrland	140	122	89	76
Jämtland	166	146	71	63
Västerbotten	175	169	124	121
Norrbotten	205	175	137	117

Table 4.3. Production with incidence and age standardized incidence (European Standard Population) for total hip replacements and knee replacements in the regions.

Consumption in the regions

Region	Hip		Knee	
	Incidence	Age standardized incidence	Incidence	Age standardized incidence
Country	146	146	114	114
Stockholm	124	144	97	114
Uppsala	153	164	107	114
Södermanland	167	154	130	119
Östergötland	124	123	98	97
Jönköping	142	139	131	129
Kronoberg	152	149	94	92
Kalmar	167	141	148	124
Gotland	235	191	125	103
Blekinge	167	148	114	101
Skåne	126	129	128	132
Halland	178	167	163	152
Västra Götaland	133	136	105	108
Värmland	133	117	110	96
Örebro	144	138	95	91
Västmanland	175	160	80	76
Dalarna	170	146	137	118
Gävleborg	183	158	139	122
Västernorrland	151	133	95	82
Jämtland	191	168	111	98
Västerbotten	183	178	133	130
Norrbotten	200	171	138	118

Table 4.4. Consumption with incidence and age standardized incidence (European Standard Population) for total hip replacements and knee replacements in the regions.



Since the start in 1979 until
December 2020, 569,070 primary
hip replacements have been
registered and 55,809 reoperations
in 400,708 individuals.

5. Hip replacement

5.1 All hip replacements due to osteoarthritis

Author: Maziar Mohaddes

The information in this chapter includes only total hip replacements performed due to osteoarthritis. The number of registered primary replacements has decreased by 25% in 2020. In 2020, 12,049 primary replacements due to osteoarthritis were registered, the corresponding number in 2019 was 16,088 (table 5.1.1). Furthermore, several private hospitals report a considerable increase of the number of operations in 2020 compared with 2019 (table 5.1.2). Between 2016 and 2019, the mean age for patients having surgery due to osteoarthritis increased. In 2019 the mean age of the patients was 69.1 years and

decreased to 68.3 years in 2020 (table 5.1.1). During the last five years, the proportions of patients in different BMI categories have been relatively constant (table 5.1.1).

Regarding ASA-class, the proportion classified as healthy (ASA-class I) continued to decrease and at the same time, the proportion of patients in ASA-class III–V (serious or life-threatening disease) increased until 2019 (table 5.1.1). The earlier trend of increasing ASA-class was discontinued in 2020. Table 5.1.3 provides a summary picture of available demographic variables for the operations at each unit.

Summary

There is probably a connection between reduced number of reported total hip replacements, decreasing mean age, decreasing ASA class and larger proportion of replacements performed in private units. The ongoing pandemic may be an important cause.

Surgical approach

Posterior and direct lateral approach in supine or lateral position has since 2005 been completely dominating in Sweden. In 2020 some of these approaches to the hip joint were used in 99.4% of the operations. The posterior approach is still most common (59%). Direct lateral approach in lateral position was used in 32% and direct lateral approach in supine position was used in 8.4% of all operations. Mini approach, Watson-Jones approach and direct lateral/posterior approach in combination with trochanteric osteotomy was used only sporadically. The distribution between the three most used approaches does not show any major variation between the sexes nor over time (figure 5.1.1 and 5.1.2).

Fixation

Completely cemented fixation is more commonly reported in females and completely uncemented fixation is more commonly reported in males (figure 5.1.3). The figure should be interpreted against the background that other factors, such as age and bone quality may have contributed to the choice of fixation. Poor results with uncemented fixation in the 1990s resulted in an increase of the use of completely cemented fixation that reached a top level at 93% around the millennium shift. Hereafter, cemented fixation has decreased every year (figure 5.1.4). In 2020 the proportion of cemented prostheses was 50%. Instead, completely uncemented fixation has become more common during the last twenty years. In 2000 the

Demography 2016–2020

	2016	2017	2018	2019	2020
Number	14,011	14,773	15,115	16,088	12,049
Age mean (SD)	68.6 (10)	68.9 (9.9)	68.90 (9.95)	69.12 (9.90)	68.25 (10.19)
Age group (%)					
<45	174 (1.2)	152 (1.0)	142 (0.9)	143 (0.9)	136 (1.1)
45–54	1,156 (8.3)	1,220 (8.3)	1,275 (8.4)	1,341 (8.3)	1,140 (9.5)
55–64	3,079 (22.0)	3,190 (21.6)	3,264 (21.6)	3,364 (20.9)	2,873 (23.8)
65–74	5,536 (39.5)	5,785 (39.2)	5,855 (38.7)	6,161 (38.3)	4,342 (36.0)
75–84	3,521 (25.1)	3,845 (26.0)	3,951 (26.1)	4,429 (27.5)	3,143 (26.1)
≥ 85	545 (3.9)	581 (3.9)	628 (4.2)	650 (4.0)	415 (3.4)
Females (%)	7,981 (57.0)	8,500 (57.5)	8,628 (57.1)	9,223 (57.3)	6,805 (56.5)
BMI (%)					
<18,5	85 (0.6)	77 (0.5)	91 (0.6)	101 (0.6)	67 (0.6)
18,5–24,9	4,258 (30.8)	4,398 (30.1)	4,527 (30.4)	4,826 (30.2)	3,704 (31.1)
25–29,9	5,926 (42.8)	6,321 (43.3)	6,389 (42.9)	6,817 (42.6)	5,078 (42.6)
30–34,9	2,787 (20.1)	2,963 (20.3)	3,034 (20.4)	3,369 (21.1)	2,421 (20.3)
35–39,9	675 (4.9)	716 (4.9)	729 (4.9)	781 (4.9)	582 (4.9)
≥40	113 (0.8)	122 (0.8)	116 (0.8)	102 (0.6)	67 (0.6)
ASA class (%)					
ASA I	3,122 (22.4)	3,153 (21.5)	3,239 (21.7)	3,164 (19.7)	2,701 (22.6)
ASA II	8,391 (60.3)	8,968 (61.1)	9,091 (60.8)	9,980 (62.3)	7,375 (61.8)
ASA III	2,346 (16.9)	2,513 (17.1)	2,558 (17.1)	2,830 (17.7)	1,840 (15.4)
ASA IV	48 (0.3)	48 (0.3)	53 (0.4)	51 (0.3)	22 (0.2)

Table 5.1.1. Demography 2016–2020.

completely uncemented replacements accounted for 2.4% of all reported operations. The corresponding proportion in 2020 was more than 30%. The increase of uncemented fixation has mainly taken place in the age groups under 65 years of age and in the age group 65–74 years (figure 5.1.4). Table 5.1.4 shows the number of operations per fixation type and age in 2020. Since 2012, the proportion of reversed hybrids (cemented cup, uncemented stem) has decreased. The proportion of hybrid arthroplasties (uncemented cup, cemented stem) has been low in the last ten-year period and amounted to about 1.5% in 2007–2010, hereafter there has been an increase to 7.1% in 2020. One hip resurfacing was performed in 2020.

Summary

There is probably a connection between reduced number of reported total hip replacements, decreasing mean age, decreasing ASA class and larger proportion of replacements performed in private units. The ongoing pandemic may be an important cause.

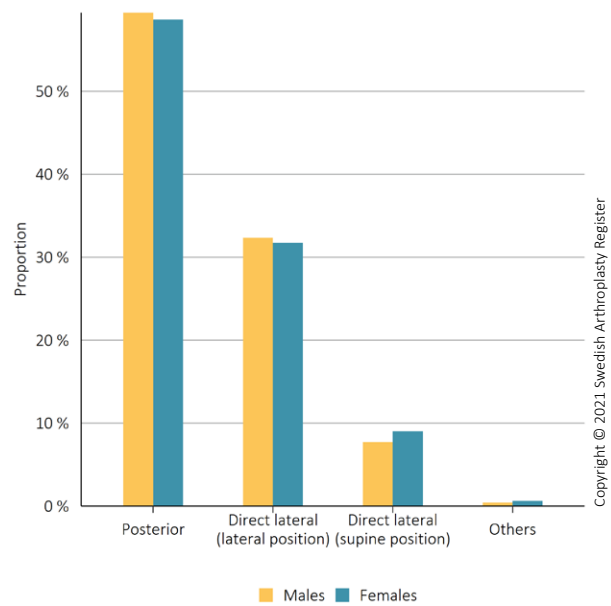


Figure 5.1.1. Distribution of surgical approach, sex.

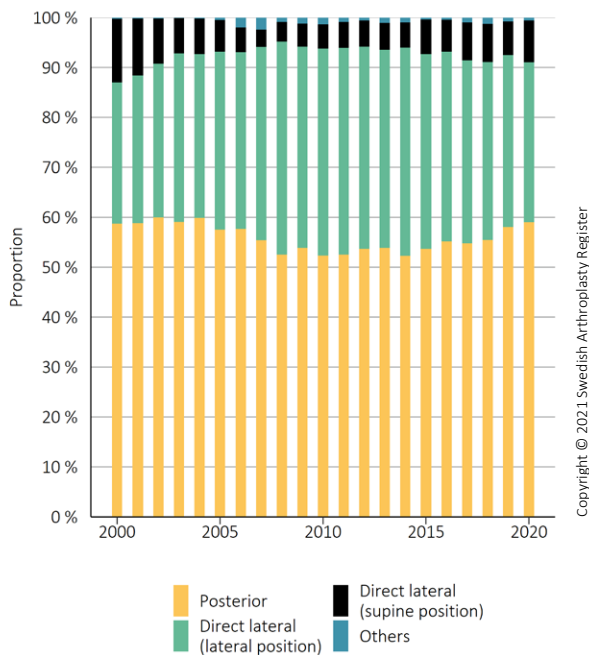


Figure 5.1.2. Time trend for surgical approach.

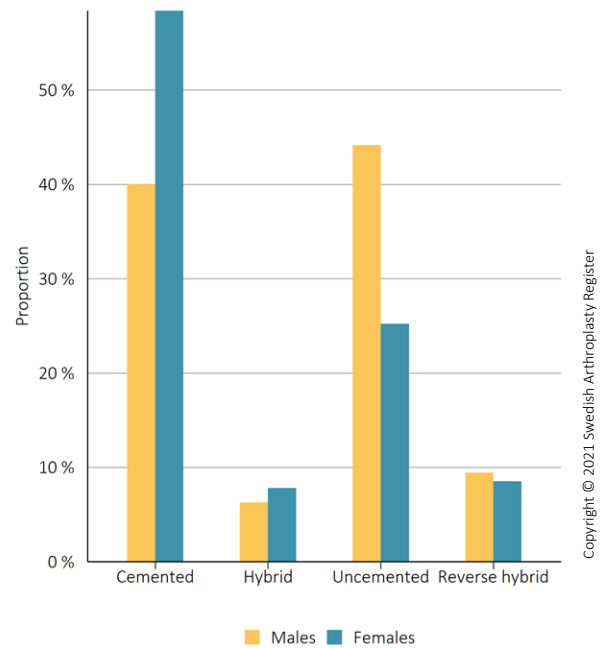


Figure 5.1.3. Distribution of fixation, sex.

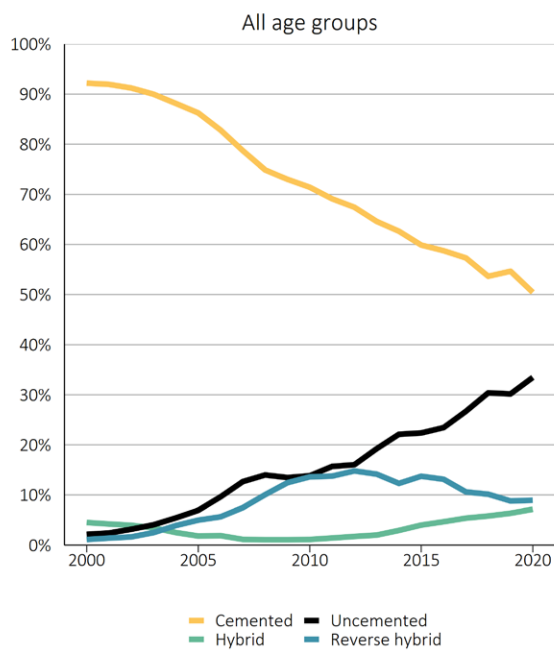


Figure 5.1.4a. Time trend for fixation method.

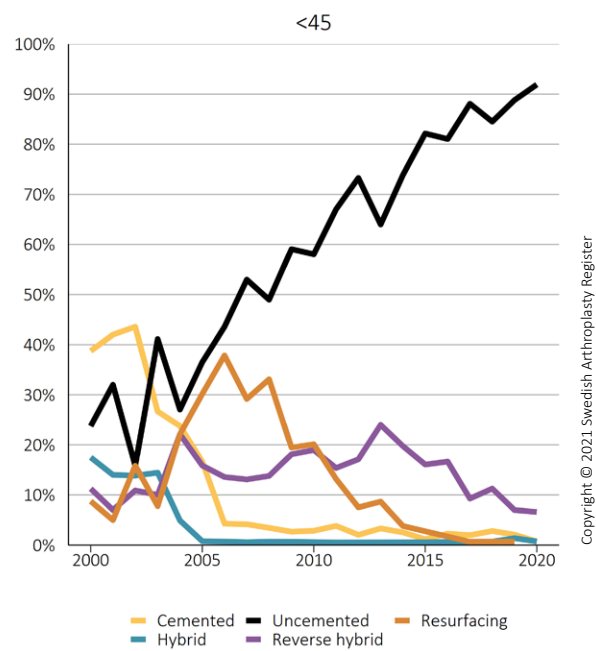


Figure 5.1.4b. Time trend for fixation method.

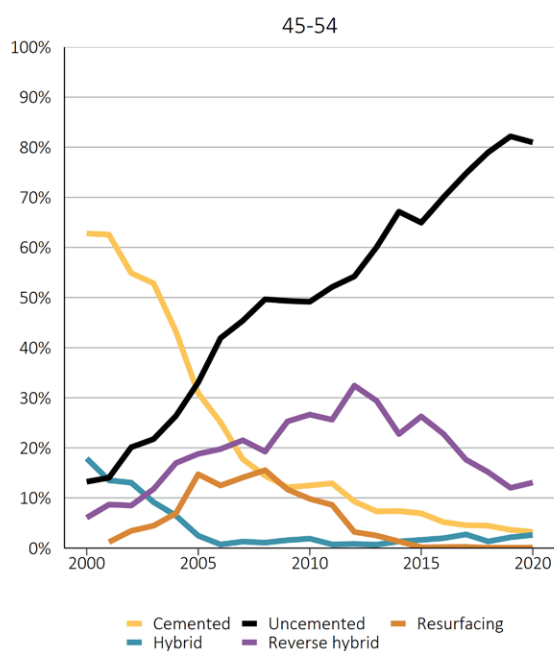


Figure 5.1.4c. Time trend for fixation method.

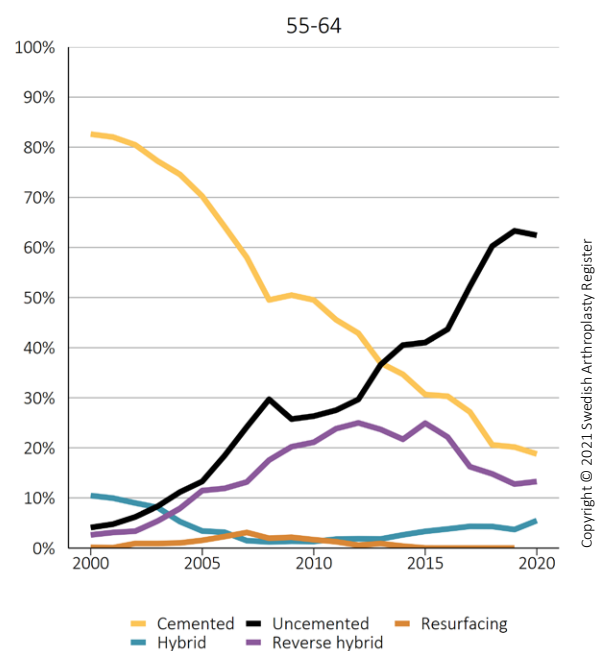


Figure 5.1.4d. Time trend for fixation method.

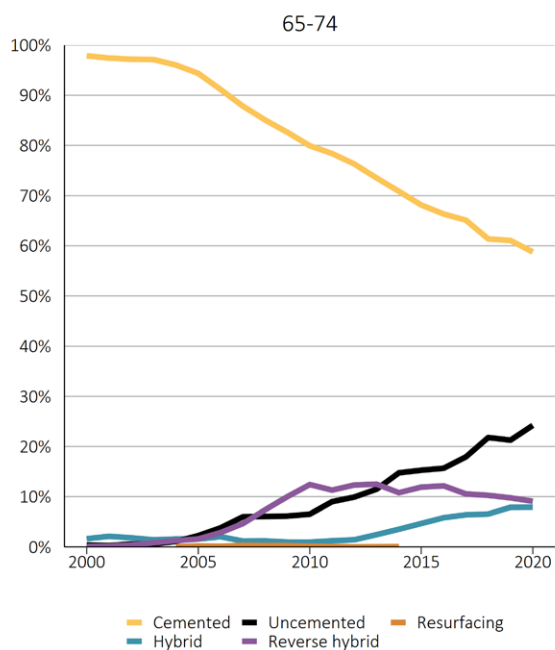


Figure 5.1.4e. Time trend for fixation method.

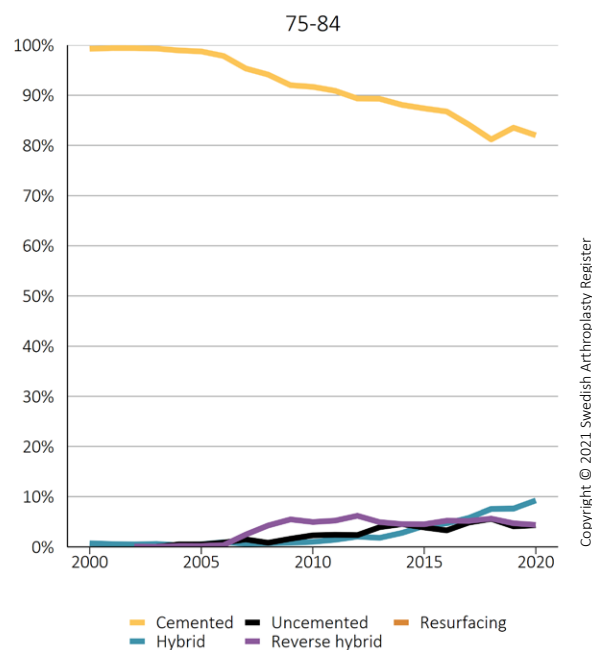


Figure 5.1.4f. Time trend for fixation method.

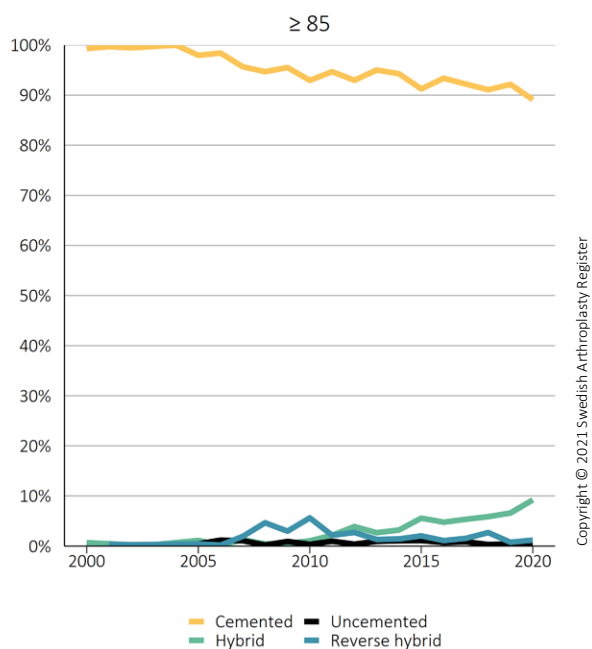


Figure 5.1.4g. Time trend for fixation method.

Choice of prosthesis

The most common prostheses are presented in tables 5.1.5–5.1.11. The five most used cups accounted for 94% of the total number of cups in their category in 2020. On the stem side, Lubinus SP II, Exeter and MS30 are dominating. Together they constitute 99% of all cemented stems. Since 2018 the register has collected data regarding type of cement. In the last three years, Refobacin and Palacos have been used in most cemented replacements reported to the register. In 2020, one of these two cement types had been used in 87% of the reported cases. Detailed information on cement type is presented in table 5.1.12 (a-d).

For uncemented cups, the differences in choice of prosthesis seem to be somewhat greater, the five most used cups account for 77%. A decrease in the use of trabecular cups can be noted. Due to the uncertainty that has arisen, some studies have noted development of radiological zones around certain trabecular cups and increased risk of dislocation for trabecular tantalum cups, the register

call for some caution with regard to their use pending reports from studies with longer follow-up. Regarding uncemented stems the diversification is less pronounced than on the cup side. Since 2009 the Corail stem has been the most common uncemented stem. The Corail stem accounts for 34% of all uncemented stems reported to the register in 2020.

The proportion of cups with highly cross-linked polyethylene continues to increase. For uncemented cups highly cross-linked polyethylene is almost exclusively used (99% of all insertions in 2020). The corresponding proportion for cemented cups was 91% in 2020. The proportion of ceramic-to-polyethylene articulation increased, from 21% in 2019 to 26% in 2020. The use of femoral heads with diameter of 32 mm continues to increase while the use of 36 mm femoral heads show a marginal reduction during the last two years. In 2020 36 mm head was used in 10% of the cases. Time trends regarding articulation and femoral head size are visualized in figures 5.1.5 and 5.1.6.

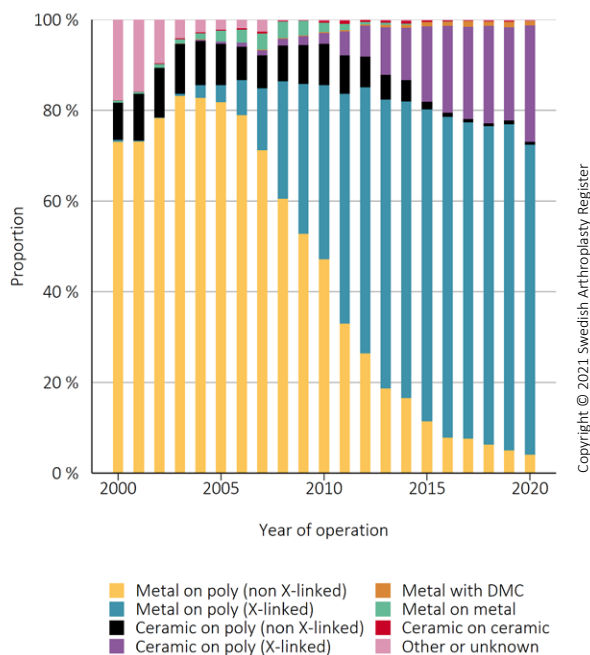


Figure 5.1.5. Time trend for articulation.

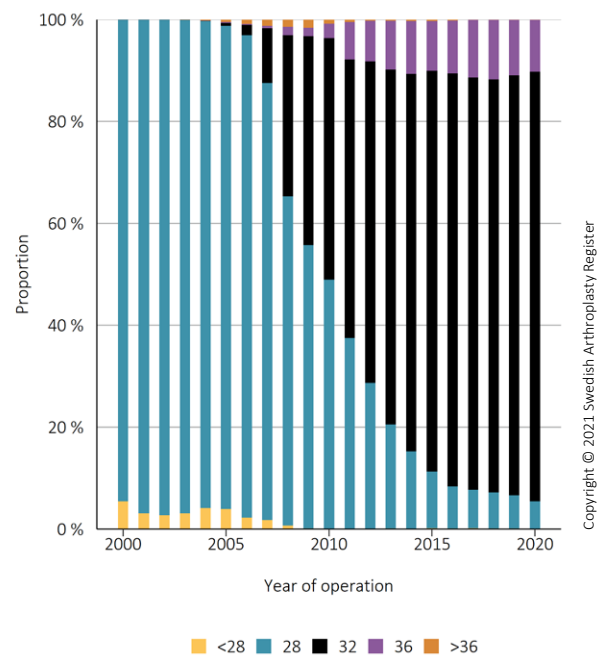


Figure 5.1.6. Time trend for head size.

Number of primary replacements per unit and year

Unit	2000–2015	2016	2017	2018	2019	2020
Akademiska sjukhuset	2,114	127	116	69	66	48
Aleris Specialistvård Bollnäs	1,076	268	267	326	265	
Aleris Specialistvård Motala	2,786	571	599	576	127	
Aleris Specialistvård Nacka	1,046	244	233	241	262	302
Aleris Specialistvård Ängelholm	218	90	59	62	220	311
Alingsås	2,685	182	186	173	175	122
Art Clinic Göteborg	25	45	75	109	94	212
Art Clinic Jönköping	49	36	71	136	190	172
Arvika	1,793	193	204	213	227	129
Bollnäs	2,597				57	230
Borås	1,798	89	74	98	115	34
Capio Artro Clinic	0		248	340	372	493
Capio Movement	1,979	334	324	364	326	427
Capio Ortopedi Motala	0				319	292
Capio Ortopediska Huset	5,115	451	592	615	667	598
Capio S:t Göran	5,909	526	538	506	533	307
Carlanderska	1,318	170	204	253	383	493
Danderyd	4,308	220	216	169	149	88
Eksjö	2,802	215	178	212	223	146
Enköping	3,324	342	407	432	413	382
Eskilstuna	797	51	68	67	45	52
Falköping	2,193				104	42
Falun	3,839	221	215	132	116	49
Frölundaortopedien	0	4	8	13	12	10
GHP Ortho Center Göteborg	928	158	168	217	283	263
GHP Ortho Center Stockholm	4,467	519	613	707	769	719
Gällivare	1,196	77	69	99	86	71
Gävle	1,847	123	87	68	90	70
Halmstad	2,647	159	157	151	183	140
Helsingborg	1,103	69	37	14	18	33
Hermelinen	22	9	22	20	24	21
Hudiksvall	1,589	91	67	57	74	39
Hässleholm	9,726	725	693	689	766	520
Jönköping	2,456	87	152	198	134	43
Kalmar	2,01	125	133	130	119	55
Karlshamn	2,731	215	210	258	286	191

Number of primary replacements per unit and year, cont.

Unit	2000–2015	2016	2017	2018	2019	2020
Karlskoga	1,917	119	22	2		
Karlskrona	185	7	4	7	6	10
Karlstad	2,309	105	91	96	78	31
Karolinska Huddinge	2,225	97	108	101	141	98
Karolinska Solna	1,818	41	34	26	13	12
Kristianstad	18	1		1		1
Kullbergska sjukhuset	3,188	188	241	245	319	217
Kungälv	2,478	176	167	153	189	64
Lidköping	2,297	281	272	160	214	145
Lindesberg	2,35	391	540	581	497	287
Linköping	861	26	21	44	59	61
Ljungby	1,784	127	160	169	153	88
Lycksele	3,743	310	309	296	230	284
Mora	2,525	258	231	230	229	207
Norrköping	2,259	186	181	166	168	113
Norrtälje	1,371	131	133	134	172	102
Nyköping	1,77	86	133	114	127	75
NÄL	2	1	4			3
Oskarshamn	2,854	297	285	284	378	275
Piteå	3,889	342	355	414	475	299
Skellefteå	1,441	101	118	113	98	92
Skene	1,428	101	143	159	153	105
Skövde	1,73	147	103	51	19	10
Sollefteå	1,712	181	296	293	298	181
Sophiahemmet	1,733	220	264	266	265	212
Specialistcenter Scandinavia	0				5	9
SU/Möndal	2,786	406	390	397	409	174
Sunderby sjukhus	573			1		3
Sundsvall	2,107	8	3	4	23	3
SUS/Lund	515	56	30	25	22	22
SUS/Malmö	411	1	1	3		
Södersjukhuset	3,444	268	228	157	193	73
Södertälje	1,595	100	131	133	125	85
Torsby	1,279	115	122	108	109	71
Trelleborg	6,599	649	598	605	579	234
Uddevalla	3,744	359	331	332	325	173

Number of primary replacements per unit and year, cont.

Unit	2000–2015	2016	2017	2018	2019	2020
Umeå	686	18	19	21	64	28
Varberg	2,894	232	210	250	215	171
Visby	1,401	107	110	102	130	106
Värnamo	1,73	151	92	127	138	98
Västervik	1,471	111	117	139	135	86
Västerås	2,701	231	324	281	371	174
Växjö	1,578	96	83	94	147	103
Ängelholm	1,412	55	141	157	180	124
Örebro	1,807	19	13	22	4	
Örnsköldsvik	2,09	170	136	114	132	81
Östersund	2,601	203	189	224	209	155

Table 5.1.2. Number of primary hip replacements per unit and year. Units with fewer than 20 primary replacements are excluded.

Case-mix per unit 2020

Unit	Number	Females, %	<55 år, %	Charnley C, %	BMI ≥35, %	ASA ≥III, %
Akademiska sjukhuset	48	56.2	14.6	35.4	14.6	54.2
Aleris Specialistvård Nacka	302	46.7	15.9	29.5	1.7	2
Aleris Specialistvård Ängelholm	311	42.8	15.1	29.3	6.8	8.4
Alingsås	122	38.5	6.6	34.4	1.6	21.3
Art Clinic Göteborg	212	38.7	9.4	25	0	1.4
Art Clinic Jönköping	172	47.1	18	33.7	5.8	0
Arvika	129	36.4	3.1	15.5	2.3	7
Bollnäs	230	47	7	26.1	2.2	14.8
Borås	34	32.4	0	35.3	11.8	47.1
Capio Artro Clinic	493	41.2	17	22.5	2.4	0.4
Capio Movement	427	42.9	9.1	25.3	7.3	18.3
Capio Ortopedi Motala	292	44.2	8.2	23.3	4.2	22.9
Capio Ortopediska Huset	598	36.6	13.9	24.9	2.5	0
Capio S:t Göran	307	41.4	4.2	24.1	3.9	40.1
Carlanderska	493	52.5	15.6	14	7.5	3.9
Danderyd	88	40.9	3.4	18.2	6.8	44.8
Eksjö	146	50.7	8.9	35.6	1.4	21.2
Enköping	382	41.1	10.7	22.8	4.5	11.5
Eskilstuna	52	42.3	5.8	34.6	3.8	36.5
Falköping	42	31	9.5	38.1	0	5

Case-mix per unit 2020, cont.

Unit	Number	Females, %	<55 år, %	Charnley C, %	BMI ≥35, %	ASA ≥III, %
Falun	49	38.8	2	28.6	21.3	44.9
Frölundaortopedien	10	50	40	10	0	0
GHP Ortho Center Göteborg	263	50.2	20.9	16.7	0.8	3.4
GHP Ortho Center Stockholm	719	42.6	13.4	26.4	2.5	0.6
Gällivare	71	38	7	25.4	11.3	25.4
Gävle	70	47.1	11.4	42.9	20	30
Halmstad	140	45.7	3.6	22.1	4.4	15.1
Helsingborg	33	45.5	0	33.3	12.1	75
Hermelinen	21	61.9	28.6	28.6	9.5	0
Hudiksvall	39	51.3	5.1	35.9	10.3	20.5
Hässleholm	520	43.3	8.8	37.5	3.3	15.3
Jönköping	43	46.5	16.3	32.6	9.3	27.9
Kalmar	55	43.6	7.3	41.8	0	25.5
Karlshamn	191	48.7	11.5	27.2	6.3	15.7
Karlskrona	10	20	20	20	30	30
Karlstad	31	51.6	16.1	32.3	3.2	32.3
Karolinska Huddinge	98	44.9	8.2	1	11.2	52
Karolinska Solna	12	50	8.3	41.7	0	54.5
Kristianstad	1					
Kullbergsga sjukhuset	217	40.6	12.4	30.4	8.3	6
Kungälv	64	32.8	7.8	39.1	9.4	12.5
Lidköping	145	43.4	5.5	29.7	9	24.8
Lindesberg	287	46.7	10.1	25.8	8	21.3
Linköping	61	42.6	18	6.6	4.3	8.9
Ljungby	88	38.6	8	37.5	6.9	18.4
Lycksele	284	37.7	10.2	33.8	12	13.1
Mora	207	46.9	5.3	16.4	6.3	23.2
Norrköping	113	47.8	9.7	18.6	2.7	16.8
Norrtälje	102	37.3	6.9	29.4	9.8	34.3
Nyköping	75	38.7	6.7	30.7	6.7	20
NÄL	3	33.3	0	66.7	0	66.7
Oskarshamn	275	48	5.1	31.3	4	12.4
Piteå	299	45.8	8.7	29.4	6.4	20.1
Skellefteå	92	44.6	5.4	13	6.6	22
Skene	105	38.1	5.7	28.6	4.8	3.8
Skövde	10	20	0	10	30	0

Case-mix per unit 2020, cont.

Unit	Number	Females, %	<55 år, %	Charnley C, %	BMI ≥35, %	ASA ≥III, %
Sollefteå	181	36.5	6.6	33.1	3.3	16.1
Sophiahemmet	212	65.6	24.1	20.3	8.6	5.3
Specialistcenter Scandinavia	9	66.7	44.4	33.3	0	0
SU/Mölnadal	174	42.5	8.6	22.4	6.3	24.1
Sunderby sjukhus	3	0	0	33.3	0	66.7
Sundsvall	3	66.7	0	0	0	100
SUS/Lund	22	59.1	0	45.5	22.7	72.7
Södersjukhuset	73	39.7	8.2	6.8	6.8	64.4
Södertälje	85	32.9	2.4	34.1	5.9	47.1
Torsby	71	31	15.5	32.4	8.5	12.7
Trelleborg	234	34.2	8.1	32.5	5.6	19.2
Uddevalla	173	46.2	7.5	31.8	9.4	32.4
Umeå	28	53.6	10.7	35.7	14.3	57.1
Varberg	171	43.9	7	20.5	7.8	12.4
Visby	106	45.3	10.4	34	7.5	15.1
Värnamo	98	46.9	8.2	32.7	3.1	34.7
Västervik	86	39.5	11.6	29.1	7	9.4
Västerås	174	41.4	3.4	24.7	7.6	32.6
Växjö	103	38.8	13.6	30.1	8.7	24.3
Ängelholm	124	51.6	11.3	35.5	4.8	21
Örnsköldsvik	81	43.2	7.4	38.3	3.7	25
Östersund	155	43.9	10.3	26.5	3.4	23.5

Table 5.1.3. Case-mix per unit 2020. Units with fewer than 20 replacements are not presented, however, included in country. Note that percentages for units with few replacements may be misleading.

Number of replacements per type of fixation and age 2020

Age group	<45	45–54	55–64	65–74	75–84	≥85
Numberl (%)	136	1,140	2,873	4,342	3,143	415
Type of fixation						
Cemented	1 (0.7)	37 (3.2)	539 (18.8)	2,551 (58.8)	2,574 (82.0)	368 (89.1)
Hybrid	1 (0.7)	30 (2.6)	158 (5.5)	344 (7.9)	290 (9.2)	38 (9.2)
Uncemented	125 (91.9)	923 (81.0)	1,792 (62.4)	1,051 (24.2)	136 (4.3)	2 (0.5)
Reverse hybrid	9 (6.6)	149 (13.1)	381 (13.3)	394 (9.1)	138 (4.4)	5 (1.2)
Resurfacing	0 (0.0)	1 (0.1)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)

Table 5.1.4. Number of operations per type of fixation and age group 2020.

Most common implants

	2000–2020	2000–2010	2011–2019	2019	2020
Number	255,830	118,031	109,662	16,088	12,049
Implant (%)					
Other	90,599 (35.4)	37,370 (31.7)	41,845 (38.2)	6,309 (39.2)	5,075 (42.1)
Lubinus (SPII standard)	58,870 (23.0)	43,579 (36.9)	14,067 (12.8)	753 (4.7)	471 (3.9)
Lubinus x-link (SPII standard)	28,493 (11.1)	22 (0.0)	21,489 (19.6)	4,160 (25.9)	2,822 (23.4)
Exeter Rim-fit (Exeter standard)	11,351 (4.4)	92 (0.1)	9,022 (8.2)	1,377 (8.6)	860 (7.1)
Exeter (Exeter standard)	9,086 (3.6)	9,027 (7.6)	59 (0.1)	0 (0.0)	0 (0.0)
Marathon (Exeter standard)	8,824 (3.4)	1,335 (1.1)	6,469 (5.9)	645 (4.0)	375 (3.1)
ZCA XLPE (MS-30 polished)	8,542 (3.3)	3,199 (2.7)	4,980 (4.5)	176 (1.1)	187 (1.6)
Contemporary Hoded Duration (Exeter standard)	5,712 (2.2)	3,826 (3.2)	1,879 (1.7)	7 (0.0)	0 (0.0)
Elite Ogee (Exeter standard)	5,537 (2.2)	5,522 (4.7)	14 (0.0)	1 (0.0)	0 (0.0)
Pinnacle W/Cripton 100 (Corail standard)	5,054 (2.0)	0 (0.0)	3,023 (2.8)	1,119 (7.0)	912 (7.6)
FAL (SPII standard)	5,026 (2.0)	4,533 (3.8)	493 (0.4)	0 (0.0)	0 (0.0)
Trilogy (CLS)	4,802 (1.9)	2,074 (1.8)	1,998 (1.8)	350 (2.2)	380 (3.2)
Reflection all-poly (Spectron EF Primary)	4,300 (1.7)	4,297 (3.6)	3 (0.0)	0 (0.0)	0 (0.0)
Exeter Rim-fit (MS-30 polished)	3,612 (1.4)	19 (0.0)	2,294 (2.1)	636 (4.0)	663 (5.5)
Contemporary (Exeter standard)	3,176 (1.2)	3,078 (2.6)	98 (0.1)	0 (0.0)	0 (0.0)
Trident hemi (Exeter standard)	2,846 (1.1)	58 (0.0)	1,929 (1.8)	555 (3.4)	304 (2.5)

Table 5.1.5. Most common implants 2000–2020.

Most common cemented implants

	2000–2020	2000–2010	2011–2019	2019	2020
Number	178,327	96,529	66,940	8,788	6,070
Implant (%)					
Lubinus (SPII standard)	58,865 (33.0)	43,578 (45.1)	14,067 (21.0)	751 (8.5)	469 (7.7)
Lubinus x-link (SPII standard)	28,445 (16.0)	22 (0.0)	21,449 (32.0)	4,156 (47.3)	2,818 (46.4)
Other	20,379 (11.4)	13,386 (13.9)	5,251 (7.8)	1,039 (11.8)	703 (11.6)
Exeter Rim-fit (Exeter standard)	11,336 (6.4)	92 (0.1)	9,012 (13.5)	1,377 (15.7)	855 (14.1)
Exeter (Exeter standard)	9,085 (5.1)	9,026 (9.4)	59 (0.1)	0 (0.0)	0 (0.0)
Marathon (Exeter standard)	8,780 (4.9)	1,335 (1.4)	6,425 (9.6)	645 (7.3)	375 (6.2)
ZCA XLPE (MS-30 polerad)	8,542 (4.8)	3,199 (3.3)	4,980 (7.4)	176 (2.0)	187 (3.1)
Contemporary Hoded Duration (Exeter standard)	5,711 (3.2)	3,826 (4.0)	1,878 (2.8)	7 (0.1)	0 (0.0)
Elite Ogee (Exeter standard)	5,537 (3.1)	5,522 (5.7)	14 (0.0)	1 (0.0)	0 (0.0)
FAL (SPII standard)	5,024 (2.8)	4,531 (4.7)	493 (0.7)	0 (0.0)	0 (0.0)
Reflection all-poly (Spectron EF Primary)	4,300 (2.4)	4,297 (4.5)	3 (0.0)	0 (0.0)	0 (0.0)
Exeter Rim-fit (MS-30 polished)	3,611 (2.0)	19 (0.0)	2,294 (3.4)	636 (7.2)	662 (10.9)
Contemporary (Exeter standard)	3,176 (1.8)	3,078 (3.2)	98 (0.1)	0 (0.0)	0 (0.0)
Charnley LPW (Charnley)	1,868 (1.0)	1,868 (1.9)	0 (0.0)	0 (0.0)	0 (0.0)
ZCA XLPE (SPII standard)	1,856 (1.0)	938 (1.0)	917 (1.4)	0 (0.0)	1 (0.0)
Charnley OGEE (Charnley)	1,812 (1.0)	1,812 (1.9)	0 (0.0)	0 (0.0)	0 (0.0)

Table 5.1.6. Most common cemented implants.

Most common uncemented implants

	2000–2020	2000–2010	2011–2019	2019	2020
Number	43,014	9,864	24,269	4,852	4,029
Implant (%)					
Other	17,056 (39.7)	5,151 (52.2)	9,063 (37.3)	1,537 (31.7)	1,305 (32.4)
Pinnacle W/Cripton 100 (Corail standard)	5,053 (11.7)	0 (0.0)	3,022 (12.5)	1,119 (23.1)	912 (22.6)
Trilogy (CLS)	4,801 (11.2)	2,074 (21.0)	1,998 (8.2)	349 (7.2)	380 (9.4)
Pinnacle 100 (Corail standard)	2,106 (4.9)	179 (1.8)	1,452 (6.0)	264 (5.4)	211 (5.2)
Pinnacle W/Cripton 100 (Corail high offset)	2,078 (4.8)	0 (0.0)	1,143 (4.7)	580 (12.0)	355 (8.8)
Allofit (CLS)	1,839 (4.3)	1,217 (12.3)	503 (2.1)	58 (1.2)	61 (1.5)
Continuum (CLS)	1,544 (3.6)	28 (0.3)	1,451 (6.0)	45 (0.9)	20 (0.5)
Exceed ABT Ringlock (Bi-Metric X por HA NC)	1,451 (3.4)	2 (0.0)	1,449 (6.0)	0 (0.0)	0 (0.0)
Trident hemi (Accolade II)	1,368 (3.2)	0 (0.0)	908 (3.7)	217 (4.5)	243 (6.0)
Pinnacle W/Cripton 100 (Corail coxa vara)	1,136 (2.6)	0 (0.0)	565 (2.3)	308 (6.3)	263 (6.5)
CLS (CLS)	870 (2.0)	806 (8.2)	64 (0.3)	0 (0.0)	0 (0.0)
Continuum (M/L Taper)	824 (1.9)	0 (0.0)	495 (2.0)	193 (4.0)	136 (3.4)
Trilogy IT (Bi-Metric X por HA NC)	796 (1.9)	1 (0.0)	777 (3.2)	18 (0.4)	0 (0.0)
Pinnacle 100 (Corail coxa vara)	752 (1.7)	35 (0.4)	411 (1.7)	163 (3.4)	143 (3.5)
Regenerex (Bi-Metric X por HA NC)	685 (1.6)	109 (1.1)	575 (2.4)	1 (0.0)	0 (0.0)
Trilogy (Corail standard)	655 (1.5)	262 (2.7)	393 (1.6)	0 (0.0)	0 (0.0)

Table 5.1.7. Most common uncemented implants.

Most common hybrid implants

	2000–2020	2000–2010	2011–2019	2019	2020
Number	8,476	2,680	3,912	1,023	861
Implant (%)					
Trident hemi (Exeter standard)	2,846 (33.6)	58 (2.2)	1,929 (49.3)	555 (54.3)	304 (35.3)
Other	1,955 (23.1)	877 (32.7)	726 (18.6)	186 (18.2)	166 (19.3)
Trilogy (SPII standard)	1,012 (11.9)	754 (28.1)	258 (6.6)	0 (0.0)	0 (0.0)
Trilogy (Spectron EF Primary)	736 (8.7)	736 (27.5)	0 (0.0)	0 (0.0)	0 (0.0)
Pinnacle W/Cripton 100 (MS-30 polished)	290 (3.4)	0 (0.0)	29 (0.7)	43 (4.2)	218 (25.3)
Pinnacle sector (SPII standard)	252 (3.0)	2 (0.1)	169 (4.3)	56 (5.5)	25 (2.9)
Tritanium (Exeter standard)	204 (2.4)	0 (0.0)	162 (4.1)	32 (3.1)	10 (1.2)
Trident AD LW (Exeter standard)	173 (2.0)	1 (0.0)	131 (3.3)	21 (2.1)	20 (2.3)
Pinnacle W/Gription Sector (MS-30 polished)	155 (1.8)	0 (0.0)	68 (1.7)	48 (4.7)	39 (4.5)
Trilogy IT (SPII standard)	139 (1.6)	0 (0.0)	92 (2.4)	25 (2.4)	22 (2.6)
Pinnacle W/Gription Sector (Exeter standard)	137 (1.6)	0 (0.0)	75 (1.9)	37 (3.6)	25 (2.9)
TOP pressfit (SPII standard)	130 (1.5)	126 (4.7)	4 (0.1)	0 (0.0)	0 (0.0)
Continuum (MS-30 polerad)	129 (1.5)	0 (0.0)	128 (3.3)	1 (0.1)	0 (0.0)
Trilogy (MS-30 polerad)	114 (1.3)	56 (2.1)	27 (0.7)	8 (0.8)	23 (2.7)
Ranawat/Burstein (SPII standard)	103 (1.2)	70 (2.6)	33 (0.8)	0 (0.0)	0 (0.0)
Continuum (SPII standard)	101 (1.2)	0 (0.0)	81 (2.1)	11 (1.1)	9 (1.0)

Table 5.1.8. Most common hybrid implants.

Most common reverse hybrid implants

	2000–2020	2000–2010	2011–2019	2019	2020
Number	23,795	7,411	13,893	1,415	1,076
Implant (%)					
Other	9,098 (38.2)	4,631 (62.5)	3,524 (25.4)	393 (27.8)	550 (51.1)
Exeter Rim-fit (Corail standard)	2,215 (9.3)	6 (0.1)	1,601 (11.5)	401 (28.3)	207 (19.2)
Marathon (Corail standard)	1,978 (8.3)	316 (4.3)	1,594 (11.5)	44 (3.1)	24 (2.2)
Lubinus (Corail standard)	1,794 (7.5)	550 (7.4)	1,129 (8.1)	83 (5.9)	32 (3.0)
Lubinus x-link (Corail standard)	1,479 (6.2)	0 (0.0)	1,055 (7.6)	241 (17.0)	183 (17.0)
Marathon (Corail high offset)	1,056 (4.4)	225 (3.0)	812 (5.8)	16 (1.1)	3 (0.3)
Marathon (ABG II HA)	983 (4.1)	92 (1.2)	891 (6.4)	0 (0.0)	0 (0.0)
Marathon (Bi-Metric X por HA NC)	844 (3.5)	145 (2.0)	698 (5.0)	1 (0.1)	0 (0.0)
Exeter Rim-fit (Corail high offset)	691 (2.9)	1 (0.0)	506 (3.6)	151 (10.7)	33 (3.1)
Lubinus (Corail coxa vara)	609 (2.6)	219 (3.0)	376 (2.7)	7 (0.5)	7 (0.7)
Lubinus x-link (Corail coxa vara)	573 (2.4)	0 (0.0)	468 (3.4)	71 (5.0)	34 (3.2)
Lubinus (CLS)	532 (2.2)	326 (4.4)	206 (1.5)	0 (0.0)	0 (0.0)
Lubinus x-link (Bi-Metric X por HA NC)	513 (2.2)	0 (0.0)	506 (3.6)	7 (0.5)	0 (0.0)
Lubinus (Bi-Metric X por HA NC)	503 (2.1)	357 (4.8)	146 (1.1)	0 (0.0)	0 (0.0)
ZCA XLPE (Corail standard)	480 (2.0)	120 (1.6)	357 (2.6)	0 (0.0)	3 (0.3)
ZCA XLPE (Bi-Metric X por HA NC)	447 (1.9)	423 (5.7)	24 (0.2)	0 (0.0)	0 (0.0)

Table 5.1.9. Most common reverse hybrid implants.

Most common cup components

	2000–2020	2000–2010	2011–2019	2019	2020
Number	25,583	11,8031	109,662	16,088	12,049
Implant (%)					
Lubinus	63,242 (24.7)	45,463 (38.5)	16,349 (14.9)	896 (5.6)	534 (4.4)
Other	44,759 (17.5)	26,429 (22.4)	14,000 (12.8)	2,540 (15.8)	1,790 (14.9)
Lubinus x-link	32,631 (12.8)	22 (0.0)	24,717 (22.5)	4,715 (29.3)	3,177 (26.4)
Exeter Rim-fit	18,816 (7.4)	119 (0.1)	13,844 (12.6)	2,688 (16.7)	2,165 (18.0)
Marathon	15,515 (6.1)	2,380 (2.0)	11,751 (10.7)	886 (5.5)	498 (4.1)
ZCA XLPE	13,199 (5.2)	5,556 (4.7)	7,267 (6.6)	178 (1.1)	198 (1.6)
Exeter	9,767 (3.8)	9,703 (8.2)	64 (0.1)	0 (0.0)	0 (0.0)
Trilogy	9,392 (3.7)	5,287 (4.5)	3,342 (3.0)	358 (2.2)	405 (3.4)
Pinnacle W/Cripton 100	8,986 (3.5)	0 (0.0)	4,886 (4.5)	2,115 (13.1)	1,985 (16.5)
Elite Ogee	8,604 (3.4)	8,353 (7.1)	250 (0.2)	1 (0.0)	0 (0.0)
Contemporary Hoded Duration	7,076 (2.8)	4,612 (3.9)	2,457 (2.2)	7 (0.0)	0 (0.0)
Trident hemi	5,786 (2.3)	604 (0.5)	3,727 (3.4)	856 (5.3)	599 (5.0)
FAL	5,225 (2.0)	4,694 (4.0)	531 (0.5)	0 (0.0)	0 (0.0)
Continuum	4,648 (1.8)	48 (0.0)	4,040 (3.7)	330 (2.1)	230 (1.9)
Reflection all-poly	4,432 (1.7)	4,423 (3.7)	9 (0.0)	0 (0.0)	0 (0.0)
Pinnacle 100	3,650 (1.4)	302 (0.3)	2,380 (2.2)	514 (3.2)	454 (3.8)

Table 5.1.10. Most common cup components.

Most common cup components

	2000–2020	2000–2010	2011–2019	2019	2020
Number	255,830	118,031	109,662	16,088	12,049
Implant (%)					
SPII standard	101,890 (39.8)	52,068 (44.1)	40,602 (37.0)	5,542 (34.4)	3,678 (30.5)
Exeter standard	51,343 (20.1)	25,603 (21.7)	21,203 (19.3)	2,834 (17.6)	1,703 (14.1)
Corail standard	19,522 (7.6)	1,980 (1.7)	13,344 (12.2)	2,472 (15.4)	1,726 (14.3)
MS-30 polished	15,531 (6.1)	4,171 (3.5)	8,547 (7.8)	1,325 (8.2)	1,488 (12.3)
Other	14,008 (5.5)	9,645 (8.2)	3,054 (2.8)	744 (4.6)	565 (4.7)
CLS	12,204 (4.8)	5,865 (5.0)	5,257 (4.8)	560 (3.5)	522 (4.3)
Bi-Metric X por HA NC	7,555 (3.0)	2,569 (2.2)	4,952 (4.5)	34 (0.2)	0 (0.0)
Spectron EF Primary	7,058 (2.8)	6,948 (5.9)	106 (0.1)	3 (0.0)	1 (0.0)
Corail high offset	6,292 (2.5)	698 (0.6)	4,101 (3.7)	943 (5.9)	550 (4.6)
Corail coxa vara	4,935 (1.9)	441 (0.4)	3,188 (2.9)	746 (4.6)	560 (4.6)
Charnley	3,692 (1.4)	3,692 (3.1)	0 (0.0)	0 (0.0)	0 (0.0)
ABG II HA	3,112 (1.2)	1,713 (1.5)	1,397 (1.3)	2 (0.0)	0 (0.0)
Accolade II	2,854 (1.1)	0 (0.0)	1,829 (1.7)	546 (3.4)	479 (4.0)
M/L Taper	2,225 (0.9)	0 (0.0)	1,212 (1.1)	277 (1.7)	736 (6.1)
CPT	2,173 (0.8)	1,812 (1.5)	263 (0.2)	57 (0.4)	41 (0.3)
Accolade straight	1,376 (0.5)	805 (0.7)	568 (0.5)	3 (0.0)	0 (0.0)

Table 5.1.11. Most common stem components.

Number and proportion of replacements per type of stem cement

	2018–2020	2018	2019	2020
Number	25,719	8,984	9,804	6,931
Stem cement n (%)				
Optipac Refobacin	7,878 (30.6)	1 (0.0)	4,642 (47.3)	3,235 (46.7)
Refobacin Bone Cement (genta)	6,309 (24.5)	4,947 (55.1)	1,008 (10.3)	354 (5.1)
Palacos R+G (genta)	5,605 (21.8)	3,616 (40.2)	1,388 (14.2)	601 (8.7)
Palacos R+G Pro	4,598 (17.9)	5 (0.1)	2,323 (23.7)	2,270 (32.8)
CMV	920 (3.6)	269 (3.0)	268 (2.7)	383 (5.5)
Other	322 (1.3)	122 (1.4)	135 (1.4)	65 (0.9)
Copal (genta + clinda)	43 (0.2)	10 (0.1)	15 (0.2)	18 (0.3)
Refobacin Revision Cement (genta + clinda)	23 (0.1)	6 (0.1)	14 (0.1)	3 (0.0)
Copal (genta + vanco)	16 (0.1)	7 (0.1)	7 (0.1)	2 (0.0)
Smartset GHV (genta)	5 (0.0)	1 (0.0)	4 (0.0)	0 (0.0)

Table 5.1.12a. Number and proportion of replacements per type of stem cement and year 2018–2020.

Number and proportion of replacements per typ of cup cement

	2018–2020	2018	2019	2020
Number	26,972	9,634	10,197	7,141
Cup cement n (%)				
Optipac Refobacin	7,599 (28.2)	1 (0.0)	4,551 (44.6)	3,047 (42.7)
Refobacin Bone Cement (genta)	6,321 (23.4)	4,939 (51.3)	1,016 (10.0)	366 (5.1)
Palacos R+G (genta)	5,901 (21.9)	4,170 (43.3)	1,250 (12.3)	481 (6.7)
Palacos R+G Pro	4,707 (17.5)	4 (0.0)	2,326 (22.8)	2,377 (33.3)
CMV	2,321 (8.6)	485 (5.0)	998 (9.8)	838 (11.7)
Copal (genta + clinda)	44 (0.2)	11 (0.1)	14 (0.1)	19 (0.3)
Refobacin Revision Cement (genta + clinda)	27 (0.1)	6 (0.1)	15 (0.1)	6 (0.1)
Smartset GHV (genta)	20 (0.1)	2 (0.0)	14 (0.1)	4 (0.1)
Other	19 (0.1)	11 (0.1)	8 (0.1)	0 (0.0)
Copal (genta + vanco)	13 (0.0)	5 (0.1)	5 (0.0)	3 (0.0)

Table 5.1.12b. Number and proportion of replacements per type of cup cement and year 2018–2020.

Number and proportion of replacements per type of the combination of stem and cup cement

	2018–2020	2018	2019	2020
Number	29,752	10,519	11,226	8,007
Combination of stem and cup n (%)				
Optipac Refobacin	8,493 (28.5)	2 (0.0)	5,062 (45.1)	3,429 (42.8)
Refobacin Bone Cement (genta)	6,910 (23.2)	5,485 (52.1)	1,086 (9.7)	339 (4.2)
Palacos R+G (genta)	6,256 (21.0)	4,374 (41.6)	1,361 (12.1)	521 (6.5)
Palacos R+G Pro	5,046 (17.0)	5 (0.0)	2,390 (21.3)	2,651 (33.1)
CMV	1,635 (5.5)	384 (3.7)	591 (5.3)	660 (8.2)
Olika cement cup/stam	1,005 (3.4)	127 (1.2)	563 (5.0)	315 (3.9)
Other	318 (1.1)	119 (1.1)	134 (1.2)	65 (0.8)
Copal (genta + clinda)	42 (0.1)	10 (0.1)	13 (0.1)	19 (0.2)
Copal (genta + vanco)	16 (0.1)	7 (0.1)	6 (0.1)	3 (0.0)
Refobacin Revision Cement (genta + clinda)	15 (0.1)	3 (0.0)	9 (0.1)	3 (0.0)
Smartset GHV (genta)	10 (0.0)	1 (0.0)	7 (0.1)	2 (0.0)
Uncemented	2 (0.0)	1 (0.0)	1 (0.0)	0 (0.0)

Table 5.1.12c. Number and proportion of replacements per type of the combination of stem and cup cement and year 2018–2020.

Number and proportion of replacements per type of the combination of stem and cup and type of fixation

	2018–2020	Cemented 2018	Hybrid 2018	Reverse hybrid 2018	Cemented 2019	Hybrid 2019	Reverse hybrid 2019	Cemented 2020	Hybrid 2020	Reverse hybrid 2020
Number	29,752	8,107	879	1,533	8,788	1,023	1,415	6,070	861	1,076
Combination of stem and cup, n (%)										
Optipac Refobacin	8,493 (28.5)	0 (0.0)	1 (0.1)	1 (0.1)	4,057 (46.2)	539 (52.7)	466 (32.9)	2,740 (45.1)	428 (49.7)	261 (24.3)
Refobacin Bone Cement (genta)	6,910 (23.2)	4,383 (54.1)	560 (63.7)	542 (35.4)	882 (10.0)	105 (10.3)	99 (7.0)	274 (4.5)	31 (3.6)	34 (3.2)
Palacos R+G (genta)	6,256 (21.0)	3,300 (40.7)	205 (23.3)	869 (56.7)	1,106 (12.6)	120 (11.7)	135 (9.5)	452 (7.4)	42 (4.9)	27 (2.5)
Palacos R+G Pro	5,046 (17.0)	4 (0.0)	1 (0.1)	0 (0.0)	1,886 (21.5)	125 (12.2)	379 (26.8)	1,897 (31.3)	291 (33.8)	463 (43.0)
CMV	1,635 (5.5)	267 (3.3)	0 (0.0)	117 (7.6)	263 (3.0)	1 (0.1)	327 (23.1)	372 (6.1)	1 (0.1)	287 (26.7)
Different cement cup/stem	1,005 (3.4)	127 (1.6)	0 (0.0)	0 (0.0)	563 (6.4)	0 (0.0)	0 (0.0)	315 (5.2)	0 (0.0)	0 (0.0)
Other	318 (1.1)	10 (0.1)	109 (12.4)	0 (0.0)	8 (0.1)	126 (12.3)	0 (0.0)	0 (0.0)	65 (7.5)	0 (0.0)
Copal (genta + clinda)	42 (0.1)	10 (0.1)	0 (0.0)	0 (0.0)	13 (0.1)	0 (0.0)	0 (0.0)	16 (0.3)	2 (0.2)	1 (0.1)
Copal (genta + vanco)	16 (0.1)	4 (0.0)	2 (0.2)	1 (0.1)	5 (0.1)	1 (0.1)	0 (0.0)	2 (0.0)	0 (0.0)	1 (0.1)
Refobacin Revision Cement (genta + clinda)	15 (0.1)	1 (0.0)	1 (0.1)	1 (0.1)	1 (0.0)	5 (0.5)	3 (0.2)	2 (0.0)	1 (0.1)	0 (0.0)
Smartset GHV (genta)	10 (0.0)	0 (0.0)	0 (0.0)	1 (0.1)	1 (0.0)	0 (0.0)	6 (0.4)	0 (0.0)	0 (0.0)	2 (0.2)
Uncemented	2 (0.0)	0 (0.0)	0 (0.0)	1 (0.1)	0 (0.0)	1 (0.1)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)

Table 5.1.12.d. Number and proportion of replacements per type of the combination of stem and cup cement and type of fixation 2018–2020.

5.2 Reoperation hip replacement

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Reoperation includes all types of surgical interventions that can be directly related to an earlier inserted hip prosthesis, regardless if the prosthesis or some of its parts are changed, extracted, or left intact. Since 2001, the absolute number of reoperations has increased successively from 2,380 to 2,474 during 2009 and 2015 and have thereafter decreased. During 2019 the number had decreased to 2,156 and during the pandemic year 2020 to 1,830 (figure 5.2.1). Between the periods 1994–1996 and 2018–2020 the percentage of reoperations related to the total production of hip prosthesis-related operations (primary operations and reoperations) has decreased about 4 percent (figure 5.2.2). The reason for this decrease is not known but may partly be due to the number of reoperations due to loosening, dislocation and periprosthetic fracture changed only marginally related to a comparatively large increase of the number of primary replacements. The change is probably real but could also be caused by underreporting especially of reoperations without change of components or extraction of at least one component.

Such procedures include among others irrigation and synovectomy or plate fixation of a periprosthetic fracture. We do not think that the reporting of these operations has decreased, it should rather have increased given the background of those studies performed to elucidate the size and causes of underreporting.

The relation between reoperations and primary operations gives a certain measure of to what extent reoperations burden the healthcare's resources for hip replacement surgery in a country or a region. It is however not a suitable measure for other means due to its sensitivity for changes in the number of performed primary operations. The quota is also affected by many other factors such as patient flow between health care regions, the indications set by the medical profession to perform reoperations and the period during which hip replacement has been practised within a care region. As given above the reporting of reoperations is less complete than the reporting of primary operations. This pertains especially to reoperations where the implant is left untouched. The reason may be that this type of reoperation often is performed by orthopaedic surgeons without a special profile towards prosthesis surgery. A lack of knowledge of the fact that reoperations

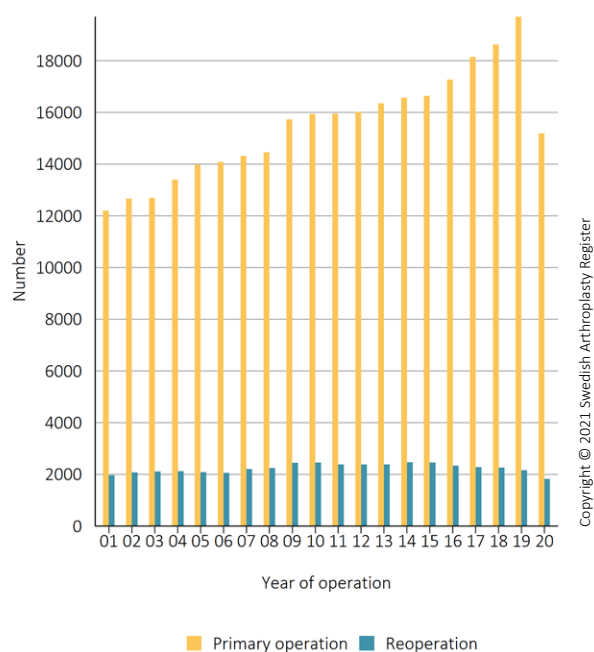


Figure 5.2.1. Number of primary and reoperations per year in 2001–2020.

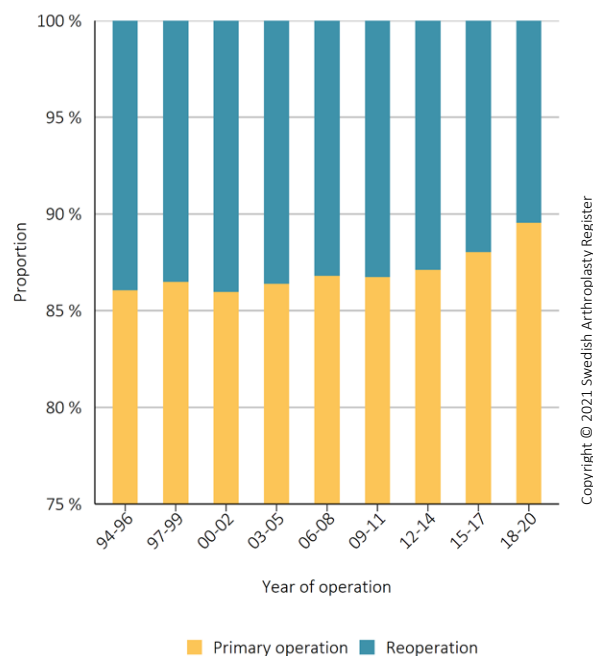


Figure 5.2.2. The distribution between reoperations (revisions and other reoperations) and primary hip replacements in 1994–2020 divided in three-years periods. The y-axis scale is adjusted and starts at 75%. The proportion of reoperations of the total number of hip related procedures has gradually been reduced and is approximately 4% lower in the last period as compared with the first three-years period.

also are to be reported to the register, even though the prosthesis has not been changed or extracted, is another reason. Insufficient penetration of the information left by the register management could also have contributed. We hope however, that the awareness in the profession of the importance of reporting also these measures, increases

successively. Linkage with the Patient Register is a possibility to catch these cases but is aggravated by the fact that the used procedure codes sometimes are too unspecific. We are eager to highlight this problem to underline the importance of using the correct code both for the diagnosis and for the surgical procedure.

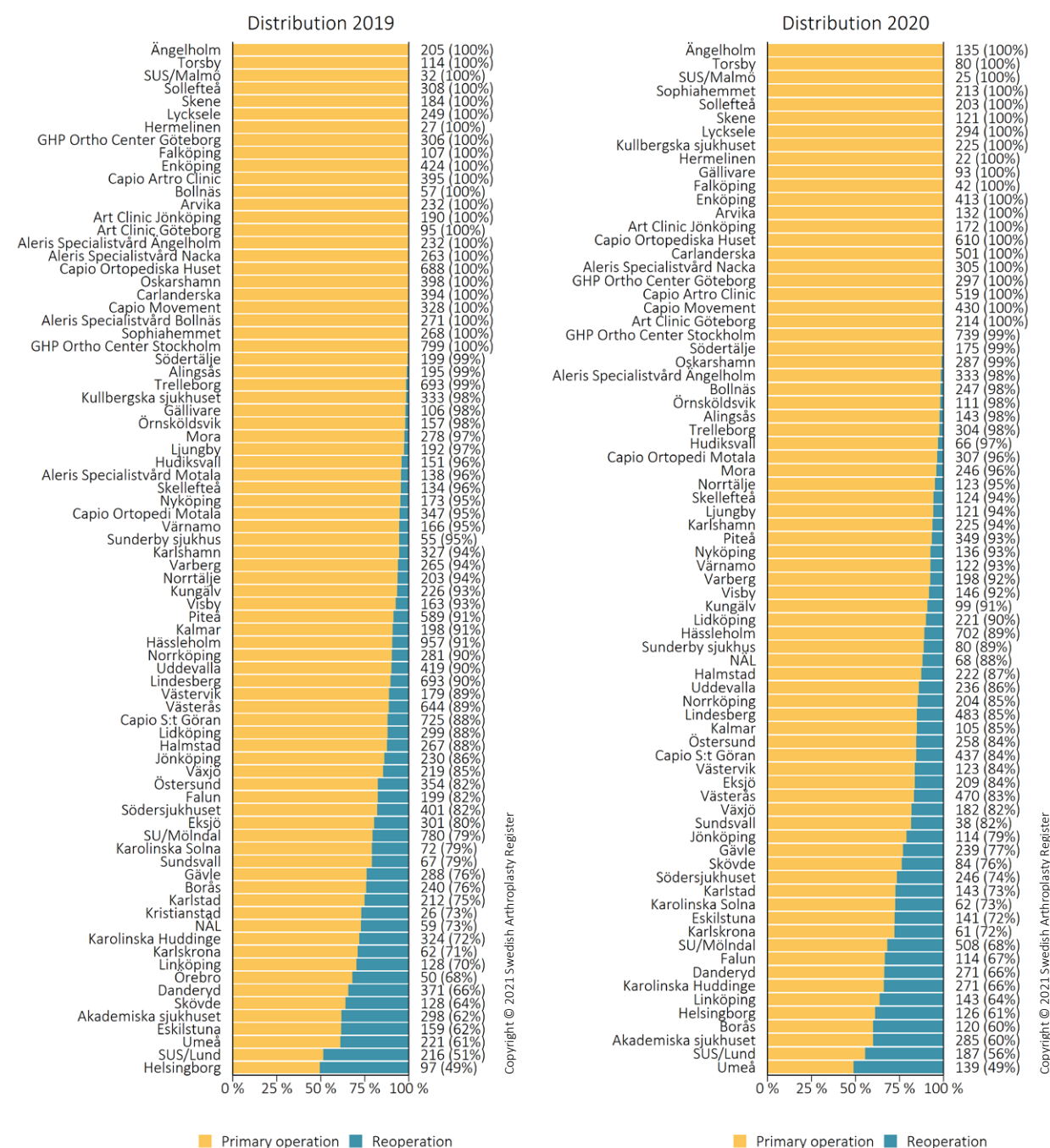


Figure 5.2.3 and 5.2.4. The distribution of primary replacements and reoperations per operating unit in the country 2019 (5.2.3) and 2020 (5.2.4). 30 of the units that performed 25 or less reoperations reported also 25 or less reoperations in 2019. Three reported more than 25 in 2019 and four none at all. The column to the right presents the number (%) of primary replacements.

Demography of reoperation from selected time periods 2008–2020.
Primary procedures performed 2018–2020 for comparison.

	Reoperation 2008–2010	Reoperation 2012–2014	Reoperation 2018–2020	Primary THR 2018–2020
Numbers	7,154	7,24	6,248	53,534
Age mean (SD)	71.88 (11.36)	71.47 (11.37)	72.30 (11.14)	69.01 (10.78)
Age group (%)				
<55	529 (7.4)	565 (7.8)	441 (7.1)	5,548 (10.4)
55–64	1,135 (15.9)	1,110 (15.3)	919 (14.7)	10,873 (20.3)
65–74	2,220 (31.0)	2,509 (34.7)	2,043 (32.7)	19,536 (36.5)
75–84	2,429 (34.0)	2,253 (31.1)	2,093 (33.5)	14,859 (27.8)
≥ 85	841 (11.8)	803 (11.1)	752 (12.0)	2,718 (5.1)
Females (%)	3,814 (53.7)	3,629 (50.2)	3,103 (49.7)	31,060 (58.0)
BMI (%)				
<18,5	100 (2.0)	110 (1.8)	84 (1.4)	623 (1.2)
18,5–24,9	1,741 (34.1)	2,002 (32.0)	1,845 (31.6)	17,241 (33.2)
25–29,9	2,024 (39.7)	2,618 (41.8)	2,335 (40.0)	21,436 (41.2)
30–34,9	924 (18.1)	1,070 (17.1)	1,115 (19.1)	9,962 (19.2)
35–39,9	235 (4.6)	358 (5.7)	343 (5.9)	2,378 (4.6)
≥40	75 (1.5)	105 (1.7)	116 (2.0)	368 (0.7)
ASA class (%)				
ASA I	795 (13.2)	743 (11.0)	445 (7.3)	10,405 (19.7)
ASA II	3,169 (52.8)	3,451 (50.9)	3,087 (50.8)	31,562 (59.7)
ASA III	1,914 (31.9)	2,442 (36.0)	2,387 (39.3)	10,619 (20.1)
ASA IV	125 (2.1)	145 (2.1)	161 (2.6)	314 (0.6)

Table 5.2.1. The distribution of sex, age, BMI and ASA class for all types of reoperations in three selected periods 2008–2020.
Data for primary replacements 2018–2020 visas för jämförelse.

Distribution of reoperations between hospitals

During 2020 (data for 2019 in parenthesis), 33.5% (29.4%) of reoperations of total replacements were performed at university or regional hospitals, 49.0% (52.2%) at county hospitals, 13.6% (13.0%) at local hospitals and 4.9% (4.5%) at private hospitals. During 2020, 12 (2019: 14) of these units carried out between 11 and 25 reoperations and 25 (21) units performed 10 or fewer reoperations (figures 5.2.3 and 5.2.4). The number of units that performed 10 or fewer reoperations per year are conspicuously many (also see chapter 5.3 for a more detailed analysis based on performed revisions).

Demography

This year's report, compares three periods (2008–2010, 2012–2014, 2018–2020). Furthermore, demographical data are shown for primary replacements performed in the last three-year period. Table 5.2.1 shows that the mean age at reoperation has increased during the last period studied to become about three years higher than at primary replacement. The proportion of males that are reoperated is higher than the proportion that have primary replacement surgery since males are reoperated more frequently than females in general. This difference also tends to increase over time. In the period 2008 to 2010, 46.3% of the reoperations were performed in males. In the period

Detailed main reason for reoperation in the last ten-year periods

Reason	2001–2010				2011–2020			
	First reoperation		A least one previous reoperation		First reoperation		A least one previous reoperation	
	Number	Proportion, %	Number	Proportion, %	Number	Proportion, %	Number	Proportion, %
Total	14,434	100	6,253	100	14,925	100	6,872	100
Loosening (regardless of time after op)	7,411	51.3	1,943	31.1	6,385	42.8	1,57	22.8
Fracture femur	2,106	14.6	719	11.5	2,297	15.4	660	9.6
Dislocation, instability, subdislocation	1,779	12.3	1,049	16.8	1,775	11.9	855	12.4
Infection	1,418	9.8	1,901	30.4	2,865	19.2	3,231	47
Osteolysis acetabulum and/or femur	714	4.9	116	1.9	343	2.3	39	0.6
Cup or liner wear	418	2.9	54	0.9	278	1.9	37	0.5
Implant breakage (including plate)	177	1.2	90	1.4	151	1	82	1.2
Unclear pain	97	0.7	56	0.9	186	1.2	81	1.2
Incorrectly inserted implant (eg. penetration)	42	0.3	18	0.3	41	0.3	10	0.1
Trochanteric problems, limp, gluteus medius rupture	40	0.3	24	0.4	111	0.7	16	0.2
Heterotopic bone formation	30	0.2	11	0.2	42	0.3	18	0.3
Loose implant part	30	0.2	18	0.3	10	0.1	8	0.1
Other reason (incl. technical)	27	0.2	10	0.2	43	0.3	15	0.2
Bleeding, hematoma	24	0.2	36	0.6	42	0.3	49	0.7
Other left material	23	0.2	54	0.9	14	0.1	14	0.2
Cement problem (loose pice of cement, inadequate cementation etc.)	22	0.2	9	0.1	30	0.2	6	0.1
Wound complication (wound rupture, wound granuloma)	20	0.1	12	0.2	21	0.1	21	0.3
Difference in leg length	18	0.1	5	0.1	16	0.1	8	0.1
Delayed fracture healing	9	0.1	85	1.4	11	0.1	63	0.9
Malignant or benign tumor	7	0	1	0	8	0.1	4	0.1
Elevated metal ions/corrosion	6	0	1	0	68	0.5	9	0.1
ALVAL/pseudotumor	5	0	2	0	126	0.8	21	0.3
Fracture under resurfacing prosthesis	5	0			24	0.2	2	0
Cyst/bursa	3	0	1	0	12	0.1	2	0
Fracture acetabulum	2	0	1	0	18	0.1	11	0.2
Not available	1	0	1	0	1	0		
Allergy (suspected or known)			1	0	2	0	2	0
Dislocation/fracture spacer			35	0.6	1	0	34	0.5
Nerve or vascular injury					2	0	1	0
Per operative fracture (previous op)					2	0	3	0

Table 5.2.2. The distribution of reasons for reoperation at detailed level in the last 20 years divided in ten-year periods for the first reoperation and for hips reoperated at least once before.

2018 to 2020 this proportion increased to 50.3% and at the same time the proportion of males having primary replacement surgery was 42.0%.

The proportion of patients in the highest BMI classes tends to increase among the reoperated. In the last three years this difference vis-à-vis the distribution of primary replacement is however not that large. It might be explained by the fact that it is more uncommon to postpone a reoperation than a primary replacement due to high BMI. Increased proportion of patients with different degrees of obesity entails an increased risk of prosthesis-related complications. Moreover, patients that are reoperated have higher ASA class in general, which is also an indicator of high risk of complications. In the periods reported, the proportion reoperated with ASA class III and IV has gradually increased.

In conclusion, males are reoperated to a larger extent than expected based on the sex distribution in primary surgery. Patients undergoing reoperation also tend to be slightly older, have slightly higher BMI and higher degree of comorbidity compared with the situation during primary surgery. Furthermore, above all the degree of comorbidity and to a lesser extent reported BMI and age tend to gradually increase in this group of patients over the past decade.

Reason for reoperation

In the Swedish Arthroplasty Registers' hip database, the reason or reasons for reoperation are registered with two variables, which means that two different reasons can be entered. For total hip replacements there are 35 different predefined reasons which in the annual report usually are condensed into main groups. As an example, it can be mentioned that three different reasons, loosening, osteolysis and wear often are presented under the main heading loosening. In table 5.2.2 reason for reoperation is presented in detail for the first two decades of the 2000s divided into first time-reoperations and reoperations proceeded by at least one previous reoperation. Because the database until 2015 had considerably more of reasons these data have been reclassified as good as possible according to the new classification. Also, in table 5.2.2 there has been some simplification. For example, all osteolysis have been merged into one group regardless of localisation. Table 5.2.2 can be used to roughly study time trends. It may also be of help in overviewing guidance to overlook

the possibilities to perform more in-depth analyses of less common reasons of reoperation.

Figure 5.2.5 presents the most common reasons for reoperation. In the period 1994–2020 the proportion of reoperations due to loosening has gradually decreased and the proportion of reoperations due to infection has increased. The proportion of dislocations has varied between 10.5 and 14.5% but has been relatively stable around 12% in the last nine years. The proportion of periprosthetic fractures increased successively until the period 2012–2014, whereafter the frequency levels out with reservation for certain underreporting of fractures not treated with change of prosthesis.

The distribution of reasons for reoperation gives above all a view of the distribution of the prosthesis-related problems that lead to reoperation but gives a limited perception of how the quality of the primary replacements performed change over time measured as proportion that ends with a reoperation. To illustrate this, we present in figure 5.2.6 the proportion of reoperated within ten years of the primary replacements performed in three-year periods starting in 1993 until 2010 so that all included into the group have a primary replacement observed for ten years. Furthermore, there is information considering the distribution of reasons in main groups. Even if the mortality probably has decreased over time, we think this only affects the outcome marginally. We then find that the proportion of reoperated within ten years decreased from 9% in the first period to a relatively stable level at just over 5% for the period between 2002 and 2004 and onwards. (Data in the previous report showed a similar trend but were not correct due to incorrect data extraction, which we regret).

Reoperation without change/extraction of implant

Reoperations without change or extraction of implants is usually done due to infection or fracture. In the beginning of the 2000s dislocation was also one of the dominating reasons but has decreased in frequency, probably since it has become increasingly rare to perform only open reduction without changing for example liner or femoral head or carry out a more comprehensive procedure such as cup and eventual stem revision. The proportion of reoperations without implant change or extraction (other open procedures in figure 5.2.7) increased until the period

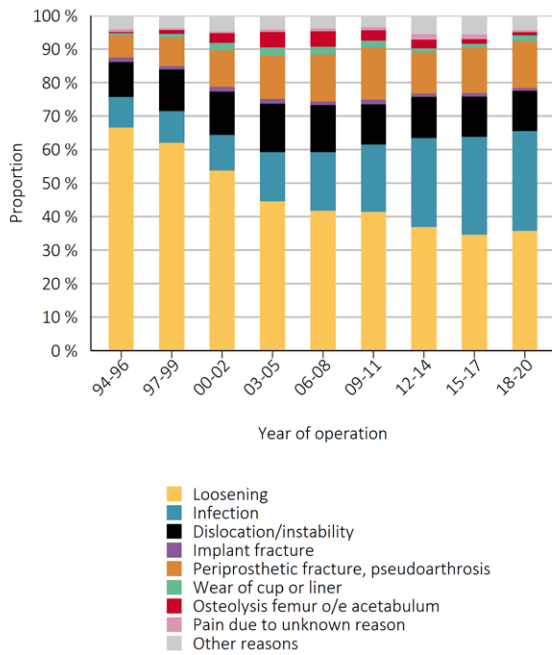


Figure 5.2.5. The eight most common reasons for reoperation in three-year periods 1994–2020.

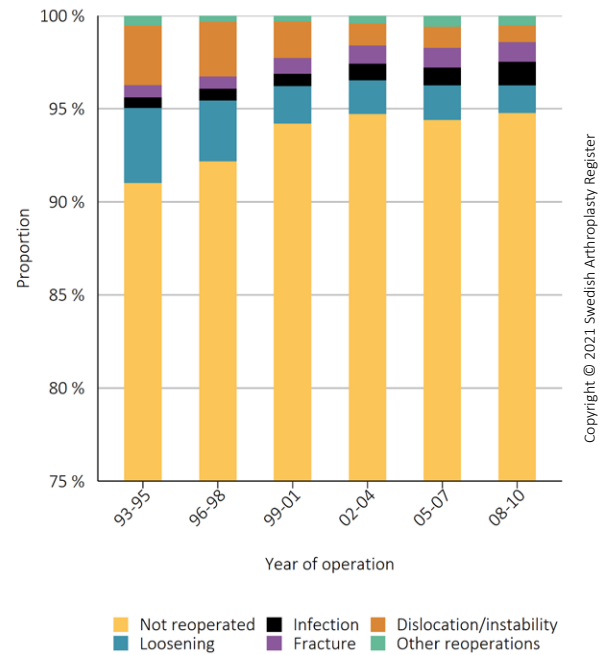


Figure 5.2.6. The distribution of reasons for reoperations within ten years after the primary total hip replacement in three-year periods 1993–2010. For all six periods, reoperations after ten years have been excluded to facilitate comparison.

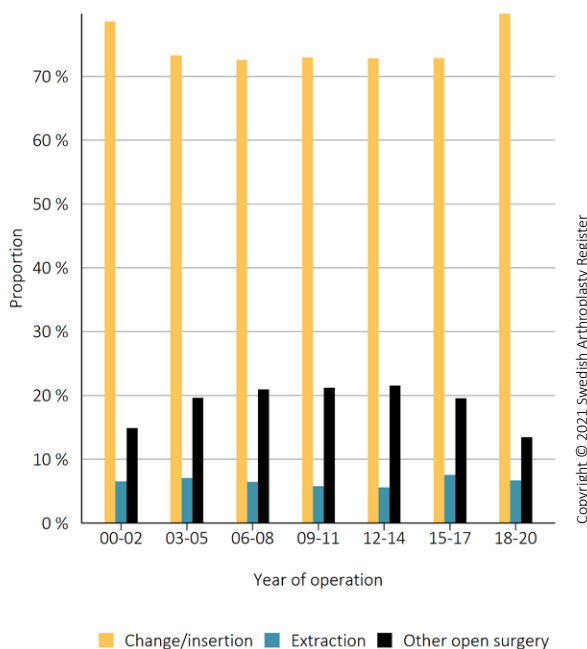


Figure 5.2.7. The distribution of the main procedures exchange/insertion, extraction and other open procedures where the implant has not been exchanged or extracted in three-year periods 2000–2020.

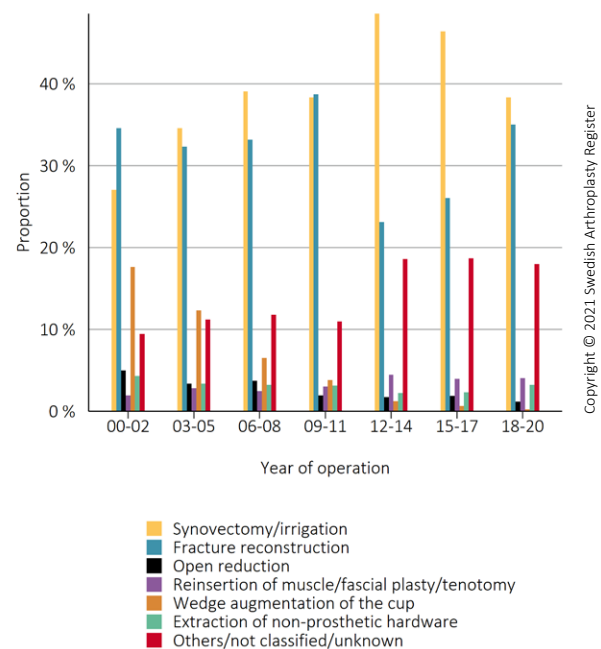


Figure 5.2.8. The distribution of procedures of "other open procedures" according to figure 5.2.7 in three-year periods.

2006 to 2008 due to an increased number of the procedures like synovectomy/irrigation and fracture reconstruction. In the last period this proportion has decreased. In general, however, procedures where the implant is left untouched are dominated by synovectomy/irrigation, especially in the latter half of the 20-year period (figure 5.2.8). Analysis in previous annual reports indicate that this procedure results in poorer healing compared with exchange of femoral head and possible liner. The relative decrease of these procedures in the last three-year period may possibly be an effect of this previously presented finding. Decreasing numbers of synovectomy/irrigation procedures without any component change or extraction points in that direction. The number of synovectomy/irrigation procedures has gradually decreased from 630 during 2017 to 242 during 2020.

The figure also shows a relatively large variation of the proportion of fracture reconstructions without prosthesis change or extraction. Here, the absolute numbers increased from 213 in 2000 to 401 in 2009 and thereafter decreased successively to 170 in 2019 and further down to 120 in 2020. This pertains mainly to fractures, distally of the tip of the stem (type C) and to some extent fractures on prosthesis level (type B), mainly where the stem is deemed fixated (type B1). Operation with acetabular wedge augment has (as has open reduction, pointed out above) decreased sharply and almost disappeared at the end of the period. This development is justified in the light of other procedures such as cup revision are considerably better at counteracting recurring dislocation in need of surgical treatment.

Summary

The proportion of reoperations related to total number of hip prosthesis operations has decreased during the past two decades from just below 15% to about 11% in the period 2018–2020, mainly because reoperations due to loosening have decreased.

Reoperations due to infection have increased. It is unclear whether this is due to a more active attitude towards surgical treatment of infected hip prosthesis or a real increase in the number of infections, but both these factors have most likely contributed to this development.

Males undergo reoperations to a greater extent than expected based on the sex distribution in primary surgery.

Patients undergoing reoperation are older, have higher BMI and higher degree of comorbidity than patients undergoing primary surgery.

In the past decade, the degree of comorbidity and, to some extent, observed BMI and age have increased among patients undergoing reoperation.

Please be sure to report all reoperations, even those where no prosthesis component is exchanged. The frequency of reoperations is one of our most important quality parameters.

5.3 Reoperation within two years

Author: Johan Kärrholm

Reoperations that occur in the first two years after primary surgery are used as a quality indicator. This is because the most common reasons for early reoperation, infection, dislocation, fracture, and early loosening are possible to influence and among other things reflect existent routines, to what extent they are compiled with, surgical technique and the unit's case-mix.

Reoperation within two years encompasses all forms of additional surgery after total replacement. This outcome measure mainly reflects early and serious complications. The indicator is therefore readily available and easier to use for clinical improvement compared to cumulative risk of revision at 10 years, which is also an important but slow and to some extent historical outcome measure. Reoperation within two years is selected by the Swedish Association of Local Authorities and Regions and the National Board of Health and Welfare as a national quality indicator and is part of "Vården i siffror". The indicator must be viewed as one of the most important and most responsive outcome measures that the Swedish Arthroplasty Register reports. The proportion of reoperations in the third year is not part of this quality indicator but is shown for increased transparency.

In contrast to previous annual reports this chapter mainly focuses on the patient group with primary osteoarthritis. In the period 2003 to 2020 this was the most common diagnosis, corresponding to 80% of all total replacements. Hip fracture diagnosis (acute or sequelae after fracture) accounted for 11.1% and tumour diagnosis 0.5% of the cases. In the remaining group (8.9%, 23,473 primary replacements) the diagnosis idiopathic necrosis, sequelae after childhood disease in the hip, and inflammatory joint disease accounted just under two thirds. The remaining part of this group is other hip trauma (except hip fracture) and other more uncommon diagnoses.

In the group with primary osteoarthritis the proportion of reoperations within two years has increased from 1.6% during the period 2003–2004 to a relatively constant level at 1.9% to 2% from the period 2009–2010 until the

period 2017–2018. The period 2019–2020 is followed-up shorter than two years and is therefore not possible to assess in the same way. In the group with "remaining diagnoses" (8.9%) as defined above, the prevalence of early reoperations was almost twice as high as in the osteoarthritis group and vary between 3.2 and 4.6% without any clear pattern. Regarding early reoperation due to hip fracture a separate part of the annual report is referred to.

In the osteoarthritis group, early reoperations due to infection has gradually increased and amounted in 2019–2020 to 65.5% which is almost a doubling compared to the period 2005–2006 (figure 5.3.1). At the same time the proportion of reoperations due to dislocation has more than halved (from 29.3 to 13.6%). The proportions in the cause groups fracture, loosening and "others" have decreased but more marginally. The relatively large increase of the proportion of infections is probably due to several factors. Most likely this is due to a more active attitude to surgical treatment when infection is suspected. The observed increase may also depend on a real increase with selection of more antibiotic-resistant stems over time and/or an increased awareness that reoperations without implant change also to be registered. Probably all these factors contribute to varying degree.

The probability for reoperation in the first three years after primary replacement is greatest in the first year (figure 5.3.2). Starting with the period 2007 to 2008 the proportion of reoperated in the first year increased from almost 1.2% in the early periods to around 1.6% from 2011 and onwards. This may probably be explained by the fact that reoperation due to infection dominates as reason in the first year. Between 2003 and 2020 56.7% of all reoperations within the first year were performed due to infection. In year two and three this proportion was reduced to around 23%. Instead, the relative proportion of loosening and other reasons increases. The proportion of reoperated due to dislocation is greatest year two and fracture as reason for reoperation is relatively constant in the three first years after primary operation.

¹ <https://vardenisiffror.se>

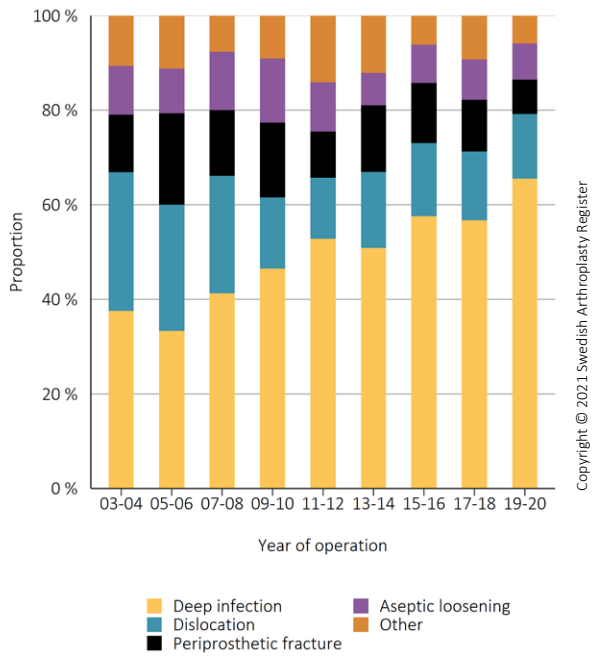


Figure 5.3.1. The distribution of reasons for reoperation within two years after the primary replacement divided in nine time-periods between 2003 and 2020. 41 of the total 6,206 reoperations (0.7%) performed between 2003 and 2020 without stated reason are excluded.

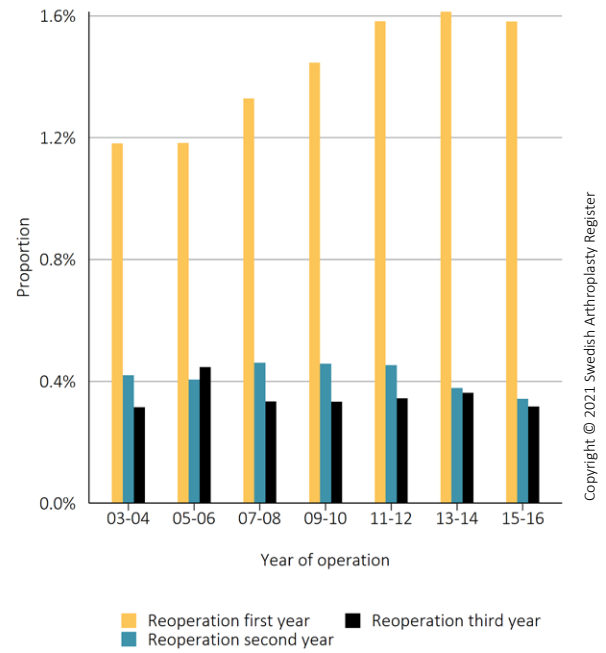


Figure 5.3.2. The proportion of reoperations in the first three years after the primary replacement related to the year of the primary surgery. The periods 2017 to 2019 and 2020 are excluded because three years of observation not has been reached for all patients.



Reoperations within two years per unit, primary replacements due to OA 2017–2020

	Primaries	Revisions	Reoperations		Deep infection		Dislocation		Fracture		Other	
Enhet	Number	Number	Number	Proportion, %	Number	Proportion, %	Number	Proportion, %	Number	Proportion, %	Number	Proportion, %
University or regional hospital												
Akademiska sjukhuset	299	10	10	3.5%	9	3.1%	0	0%	0	0%	1	0.5%
Karolinska Huddinge	448	10	10	2.4%	6	1.3%	2	0.6%	1	0.2%	1	0.3%
Karolinska Solna	85	3	4	4.9%	3	3.5%	0	0%	0	0%	1	1.4%
Linköping	185	4	4	2.2%	2	1.1%	2	1.1%	0	0%	0	0%
SU/Mölndal	1,37	29	32	2.5%	21	1.6%	5	0.4%	3	0.2%	3	0.2%
SUS/Lund	99	2	2	2%	2	2%	0	0%	0	0%	0	0%
Umeå	131	4	4	3.1%	3	2.3%	1	0.8%	0	0%	0	0%
Örebro	39	0	0	0%	0	0%	0	0%	0	0%	0	0%
County hospital												
Borås	321	4	4	1.4%	2	0.6%	1	0.3%	1	0.4%	0	0%
Danderyd	622	20	21	3.6%	10	1.7%	4	0.7%	7	1.2%	0	0%
Eksjö	759	24	25	3.5%	22	3%	1	0.1%	1	0.2%	1	0.2%
Eskilstuna	232	5	7	3.2%	6	2.7%	0	0%	0	0%	1	0.5%
Falun	512	9	22	4.5%	8	1.6%	0	0%	0	0%	14	2.9%
Gävle	315	5	5	1.7%	3	1%	2	0.7%	0	0%	0	0%
Halmstad	631	12	13	2.1%	10	1.6%	0	0%	1	0.2%	0	0%
Helsingborg	102	5	5	5.8%	4	4.7%	0	0%	1	1.1%	0	0%
Hässleholm	2,667	29	32	1.3%	25	1%	1	0%	4	0.2%	2	0.1%
Jönköping	527	9	12	2.4%	7	1.3%	0	0%	0	0%	5	1%
Kalmar	437	4	5	1.2%	3	0.7%	1	0.2%	1	0.2%	0	0%
Karlskrona	27	0	0	0%	0	0%	0	0%	0	0%	0	0%
Karlstad	296	14	14	4.9%	13	4.4%	0	0%	1	0.4%	0	0%
Norrköping	628	4	4	0.7%	4	0.7%	0	0%	0	0%	0	0%
Skövde	183	8	9	5%	7	3.8%	1	0.6%	1	0.5%	0	0%
Sundsvall	33	0	0	0%	0	0%	0	0%	0	0%	0	0%
Södersjukhuset	650	13	15	2.4%	8	1.2%	4	0.6%	2	0.4%	1	0.2%
Uddevalla	1,161	25	25	2.3%	23	2.1%	1	0.1%	0	0%	1	0.1%
Varberg	846	6	9	1.2%	5	0.7%	0	0%	2	0.3%	2	0.2%
Västerås	1150	37	38	3.5%	26	2.3%	4	0.3%	2	0.2%	5	0.5%
Växjö	427	18	18	4.5%	13	3.1%	4	1.2%	0	0%	1	0.2%
Östersund	777	22	22	3.1%	11	1.5%	4	0.5%	4	0.5%	3	0.4%

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Reoperations within two years per unit, primary replacements due to OA 2017–2020, cont.

	Primaries	Revisions	Reoperations		Deep infection		Dislocation		Fracture		Other	
Enhet	Number	Number	Number	Proportion, %	Number	Proportion, %	Number	Proportion, %	Number	Proportion, %	Number	Proportion, %
Local hospitals												
Alingsås	656	5	12	2%	10	1.6%	2	0.4%	0	0%	0	0%
Arvika	773	33	34	4.8%	25	3.3%	0	0%	4	0.6%	5	0.9%
Bollnäs	287	3	3	1.1%	2	0.8%	0	0%	0	0%	1	0.3%
Enköping	1,634	34	34	2.4%	13	0.8%	7	0.5%	2	0.1%	12	1%
Falköping	146	3	3	2.1%	3	2.1%	0	0%	0	0%	0	0%
Gällivare	325	0	0	0%	0	0%	0	0%	0	0%	0	0%
Hudiksvall	236	1	1	0.4%	1	0.4%	0	0%	0	0%	0	0%
Karlshamn	945	20	21	2.5%	6	0.7%	10	1.2%	3	0.4%	2	0.2%
Karlskoga	23	0	0	0%	0	0%	0	0%	0	0%	0	0%
Kullbergsga sjukhuset	1,022	28	34	3.6%	20	2%	5	0.5%	1	0.1%	8	1%
Kungälv	573	19	19	3.5%	16	2.9%	0	0%	0	0%	3	0.5%
Lidköping	790	14	14	1.9%	4	0.5%	4	0.6%	2	0.3%	4	0.5%
Lindesberg	1,905	18	21	1.2%	12	0.7%	2	0.1%	3	0.2%	3	0.2%
Ljungby	569	7	7	1.4%	3	0.5%	2	0.4%	1	0.2%	1	0.3%
Lycksele	1,118	11	13	1.4%	4	0.4%	2	0.3%	3	0.3%	4	0.5%
Mora	896	9	12	1.5%	10	1.3%	2	0.2%	0	0%	0	0%
Norrköping	541	15	15	3.1%	9	1.8%	2	0.4%	1	0.2%	3	0.7%
Nyköping	449	12	13	2.9%	10	2.3%	0	0%	0	0%	2	0.5%
Oskarshamn	1,222	16	17	1.6%	15	1.4%	2	0.2%	0	0%	0	0%
Piteå	1,543	12	12	0.9%	0	0%	6	0.4%	1	0.1%	3	0.3%
Skellefteå	421	4	4	1.2%	1	0.2%	0	0%	0	0%	3	0.9%
Skene	559	8	10	1.9%	7	1.3%	1	0.2%	0	0%	2	0.4%
Sollefteå	1,068	10	11	1.1%	8	0.8%	0	0%	2	0.2%	1	0.1%
Södertälje	474	5	7	1.6%	3	0.6%	0	0%	2	0.4%	2	0.5%
Torsby	410	14	14	3.6%	9	2.3%	4	1.1%	0	0%	0	0%
Trelleborg	2,016	25	25	1.3%	13	0.7%	5	0.3%	5	0.3%	1	0.1%
Visby	448	4	6	1.5%	2	0.4%	0	0%	2	0.4%	2	0.6%
Värnamo	454	10	11	2.5%	10	2.3%	1	0.2%	0	0%	0	0%
Västervik	477	8	8	1.7%	5	1.1%	2	0.4%	1	0.2%	0	0%
Ängelholm	602	8	8	1.4%	5	0.8%	1	0.2%	1	0.2%	1	0.2%
Örnsköldsvik	463	6	6	1.6%	4	1%	1	0.3%	0	0%	1	0.3%

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Reoperations within two years per unit, primary replacements due to OA 2017–2020, cont.

	Primaries	Revisions	Reoperations		Deep infection		Dislocation		Fracture		Other	
Enhet	Number	Number	Number	Proportion, %	Number	Proportion, %	Number	Proportion, %	Number	Proportion, %	Number	Proportion, %
Private hospitals												
Aleris Specialistvård Bollnäs	858	9	10	1.2%	5	0.6%	3	0.4%	0	0%	2	0.3%
Aleris Specialistvård Motala	1,302	17	19	1.5%	10	0.8%	3	0.2%	0	0%	6	0.5%
Aleris Specialistvård Nacka	1,038	11	11	1.1%	3	0.3%	3	0.3%	2	0.2%	3	0.3%
Aleris Specialistvård Ängelholm	652	15	15	2.8%	7	1.1%	6	1.1%	0	0%	2	0.6%
Art Clinic Göteborg	490	4	4	0.9%	0	0%	1	0.3%	2	0.4%	0	0%
Art Clinic Jönköping	569	2	2	0.5%	1	0.3%	1	0.3%	0	0%	0	0%
Capio Arthro Clinic	1,453	28	32	2.7%	20	1.8%	3	0.2%	2	0.1%	5	0.4%
Capio Movement	1,441	19	21	1.8%	8	0.6%	4	0.4%	3	0.2%	6	0.5%
Capio Ortopedi Motala	611	10	11	1.9%	10	1.6%	0	0%	0	0%	1	0.3%
Capio Ortopediska Huset	2,472	25	30	1.5%	14	0.6%	0	0%	2	0.1%	14	0.8%
Capio S:t Göran	1,882	24	32	1.8%	9	0.5%	5	0.3%	8	0.5%	9	0.6%
Carlanderska	1,333	11	11	1.1%	7	0.8%	1	0.1%	0	0%	2	0.2%
Frölundaortopedien	43	1	1	2.7%	1	2.7%	0	0%	0	0%	0	0%
GHP Ortho Center Göteborg	931	13	13	1.6%	11	1.3%	0	0%	1	0.1%	1	0.2%
GHP Ortho Center Stockholm	2,808	39	40	1.6%	17	0.7%	12	0.5%	6	0.2%	5	0.2%
Hermelinen	87	0	0	0%	0	0%	0	0%	0	0%	0	0%
Sophiahemmet	1,007	14	17	1.7%	8	0.8%	3	0.3%	4	0.4%	2	0.2%
Country	58,012	939	1,035	2%	617	1.1%	144	0.3%	96	0.2%	164	0.3%

Table 5.3.1. Reoperations within two years per unit based on primary replacements due to osteoarthritis 2017–2020. Units with fewer than 20 primary replacements in the current period are excluded.

1) Refers to the number of operations with short-term complication, which may differ from the sum of the number of complications as each operation may have more than one type of complication.

2) All proportions are calculated using competing risk analysis at two-years follow-up.

Reoperations within two years per unit, primary replacement due to OA

Unit	2014–2017 Proportion, %	2015–2018 Proportion, %	2016–2019 Proportion, %	2017–2020 Proportion, %
University or regional hospital				
Akademiska sjukhuset	3.2%	2.6%	3%	3.5%
Karolinska Huddinge	1.4%	2%	2.1%	2.4%
Karolinska Solna	2.2%	2.9%	4.4%	4.9%
Linköping	0%	1.6%	2%	2.2%
SU/Mölnadal	2.2%	2.2%	2.7%	2.5%
SUS/Lund	0.9%	2.3%	1.5%	2%
Umeå	2.1%	4.9%	3.3%	3.1%
Örebro	3%	3.3%	0%	0%
County hospital				
Borås	2.2%	2%	1.6%	1.4%
Danderyd	3.7%	3.9%	3.6%	3.6%
Eksjö	2.9%	3.9%	3.6%	3.5%
Eskilstuna	2.5%	2.2%	3.5%	3.2%
Falun	2.6%	3.5%	4.1%	4.5%
Gävle	1.7%	2.2%	2%	1.7%
Halmstad	2.2%	2.3%	2%	2.1%
Helsingborg	1%	1.9%	3%	5.8%
Hässleholm	1.7%	1.4%	1.4%	1.3%
Jönköping	2.1%	2.9%	2.7%	2.4%
Kalmar	1%	0.9%	1.2%	1.2%
Karlskrona	*	8.3%	4.2%	0%
Karlstad	3%	3.9%	4.6%	4.9%
Norrköping	1.3%	1%	1.4%	0.7%
Skövde	3.5%	4.3%	4.4%	5%
Sundsvall	2.5%	1.8%	0%	0%
Södersjukhuset	2.6%	2.5%	2.4%	2.4%
Uddevalla	2.7%	2.6%	2.3%	2.3%
Varberg	1.3%	1.3%	1.4%	1.2%
Västerås	2.5%	2.6%	3%	3.5%
Växjö	2.2%	4.9%	4.8%	4.5%
Östersund	2.2%	2.3%	3%	3.1%

The table continues on the next page.

Reoperations within two years per unit, primary replacement due to OA, cont.

Unit	2014–2017 Proportion, %	2015–2018 Proportion, %	2016–2019 Proportion, %	2017–2020 Proportion, %
Local hospital				
Alingsås	1.5%	1.7%	1.8%	2%
Arvika	4.2%	4.9%	4.7%	4.8%
Bollnäs	-	-	3.5%	1.1%
Enköping	2%	2%	2.1%	2.4%
Falköping	-	-	1.9%	2.1%
Gällivare	0.4%	0.3%	0.3%	0%
Hudiksvall	2.4%	2%	1%	0.4%
Karlshamn	2.5%	2.3%	2.5%	2.5%
Karlskoga	3.1%	3.2%	4.3%	0%
Kullbergsga sjukhuset	3.5%	3.9%	4.1%	3.6%
Kungälv	2.5%	2.7%	3.3%	3.5%
Lidköping	2.1%	2.2%	2.1%	1.9%
Lindesberg	1%	1.1%	1.3%	1.2%
Ljungby	2.8%	2.3%	1.9%	1.4%
Lycksele	1.8%	1.8%	1.9%	1.4%
Mora	1.2%	1.2%	1.4%	1.5%
Norrtälje	3.1%	2.6%	2.5%	3.1%
Nyköping	2.9%	2.6%	2.8%	2.9%
Oskarshamn	0.9%	1%	1.4%	1.6%
Piteå	0.8%	0.8%	0.9%	0.9%
Skellefteå	2.2%	1.6%	1.2%	1.2%
Skene	1%	1.3%	1.3%	1.9%
Sollefteå	2.1%	1.9%	1.6%	1.1%
Södertälje	3.9%	3.3%	2.7%	1.6%
Torsby	3.3%	3.8%	3.5%	3.6%
Trelleborg	1.3%	1.4%	1.5%	1.3%
Visby	2.2%	2.1%	1.8%	1.5%
Värnamo	1.2%	1%	1.4%	2.5%
Västervik	1.5%	1.1%	1.6%	1.7%
Ängelholm	1.4%	0.8%	1.3%	1.4%
Örnsköldsvik	1%	1.2%	1.4%	1.6%

The table continues on the next page.

Reoperations within two years per unit, primary replacement due to OA, cont.

Unit	2014–2017 Proportion, %	2015–2018 Proportion, %	2016–2019 Proportion, %	2017–2020 Proportion, %
Private hospital				
Aleris Specialistvård Bollnäs	1.5%	1.5%	1.1%	1.2%
Aleris Specialistvård Motala	1.8%	1.7%	1.7%	1.5%
Aleris Specialistvård Nacka	2%	1.8%	1.6%	1.1%
Aleris Specialistvård Ängelholm	0.9%	0.9%	2.4%	2.8%
Art Clinic Göteborg	2.1%	1.2%	0.9%	0.9%
Art Clinic Jönköping	0%	0.8%	0.5%	0.5%
Capio Artro Clinic	2.4%	2.4%	2.9%	2.7%
Capio Movement	3.1%	2.1%	2%	1.8%
Capio Ortopedi Motala	-	-	2.8%	1.9%
Capio Ortopediska Huset	0.9%	1.1%	1.3%	1.5%
Capio S:t Göran	2%	1.9%	1.8%	1.8%
Carlanderska	1.1%	1%	1.2%	1.1%
Frölundaortopedien	*	4%	2.7%	2.7%
GHP Ortho Center Göteborg	0.7%	1.1%	1.3%	1.6%
GHP Ortho Center Stockholm	1.5%	1.6%	1.5%	1.6%
Hermelinen	0%	0%	0%	0%
Sophiahemmet	2.2%	2%	2.1%	1.7%
Country	1.9%	2%	2%	2%

Table 5.3.2. Reoperations within two years per unit based on primary total hip replacements performed due to osteoarthritis 2017–2020.

1) All proportions are calculated using competing risk analysis at two-years follow-up.

*) Fewer than 20 replacements in the period.

-) No primary replacements reported.

5.4 Revision

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Revision of a hip replacement means that a patient with a primary or secondary hip replacement is operated again with exchange or extraction of the entire prosthesis or parts of it. If this procedure is performed in two sessions (two-stage procedure) these two operations are registered as one procedure (if not otherwise noted). If for example a primary replacement is revised in two sessions the extraction date will become date of revision of the primary operation, while the date of insertion will become the date of start of observation of a first-time revision. If the prosthesis is extracted for good (no prosthesis insertion is registered at the last date of observation, in this year's report, 2020-12-31) the extraction is classified as permanent. Absence of reported prosthesis insertion after previous extraction is thus decisive if the extraction is to be viewed as permanent or not. This means that some extractions during the latter part of 2020 where insertion is planned in 2021 incorrectly may have been classified as permanent.

Since 1979 revisions (and other reoperations) are reported on individual level, which means that more comprehensive data can be retrieved more than 40 years back in time. Primary operations were on the other hand classified on aggregated unit level up to 1991 and individual registration linked to the personal identity number was not started until 1992. In 1999 more detailed registration of inserted implant components was added including both primary operations and revisions.

Over time, an increasing proportion of the primary replacements performed during a certain year will be revised while the proportion of patients still alive will decrease. Most patients will however not be revised during their remaining lifetime. In figure 5.4.1 we see that of the patients operated in 1994, 76.8% retained their prosthesis to the end of their lives, 8.8% were still live with their primary prosthesis and 12.4% have been revised at least one time of which 6.4% are still alive. The closer to the present you move in the diagram the more patients live and retains their primary prosthesis. For patients operated in 2011, ten years ago, the corresponding distribution is 24.2% deceased with primary prosthesis, 72.1% who live with primary prosthesis, 0.8% deceased after at least one revision and 2.9% who are alive after at least one revision. Since the year 2000 both the number of primary operations as well as the revisions has increased, but the increase

of primary operations has been greater. In the period 2000–2002, 12,062 primary hip replacements were reported per year. In the same period the number of revisions per year was 1,595 (11.7%). The majority of these (9.1%) were first-time revisions and the others (2.6%) were multiple-time revisions. About 20 years later (2018–2020) the corresponding number of primary hip replacements amounted to 17,845 (91.2% of all primary operations + revisions) and the number of revisions amounted to 1,720 per year (8.8%) of which 6.8% were first-time revisions and 2.0% were multiple-time revisions (figures 5.4.2 and 5.4.3).

Given that the elderly and that the number of persons having hip replacement increases in the population, one would expect that the number of hips that have been revised multiple times also increases. Since 2000 the multiple-time revisions have on average been 21.8% of all revisions with a variation between approximately 19.0% (in 2006) and 23.4% (in 2020) without any clear trend over time. The number of first-time revisions has increased from 1,226 in 2000 to 1,628 in 2019. In the pandemic year, 2020, the number of first-time revisions decreased to 1,336 while the number of reported multiple-time revisions decreased marginally, from 415 to 409. In summary the number of revisions increased from just under 1,600 per year in 2000 to about 2,000 in 2009, hereafter the number has fluctuated around 2,000 up to 2019 to be reduced to 1,745 in 2020, mainly due to fewer first-time revisions.

Patients undergoing revision differ (as do those undergoing reoperation) demographically from the patients having primary replacement. In general, they are older, more often males, and have higher degree of comorbidity (table 5.4.1). The diagnosis, primary osteoarthritis, is less common among revision cases and especially so among the patients revised several times. The relative proportion of hips with acute hip fracture is also lower in the revision group than in the primary group and becomes even lower in the multiple-time revision group. High comorbidity and mortality in this group are contributing factors. The patients who have at least one revision and must undergo another revision have in general also higher degree of comorbidity, here measured as ASA class and an even larger proportion of them have initially been operated due to secondary osteoarthritis. The mean BMI is relatively similar between the groups, however, with a tendency to higher proportion of patients with BMI 30 or more among revision cases.

Revision volume per hospital

For several years we have followed the distribution of operation volumes and have noted that some hospitals only perform few cases per year. In the analysis below we have also added revision of hemiarthroplasties to provide as fair view as possible. In 2020 primary replacements were performed at 82 different units. At 63 of these, revisions were also performed and at 44 of those also multiple-time revisions. At eight of the units that also performed multiple-time revisions, 10 or fewer revisions were performed in 2020.

Compared with the year before, the change regarding the number of units with low volume of revisions is unchanged. In 2019 as well as 2020, 39 units had a revision volume of 25 procedures or fewer and 22 and 23 respectively of these reported a volume of 10 procedures or fewer. The number of units performing more than 50 revisions decreased from 17 to 12 between 2019 and 2020 and the number of units performing 100 or more decreased from 4 (Danderyd, SUS/Lund, Akademiska Sjukhuset Uppsala, SU/Mölndal) to 2 (Akademiska Sjukhuset Uppsala, SU/Mölndal).

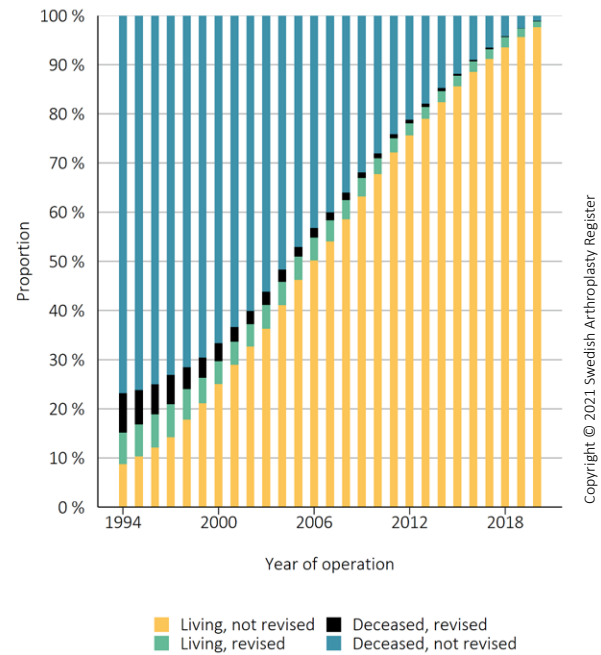


Figure 5.4.1. Distribution of patients with primary replacement and revision having surgery 1993–2020 divided into those who were alive and those who had died 31st of December 2020.

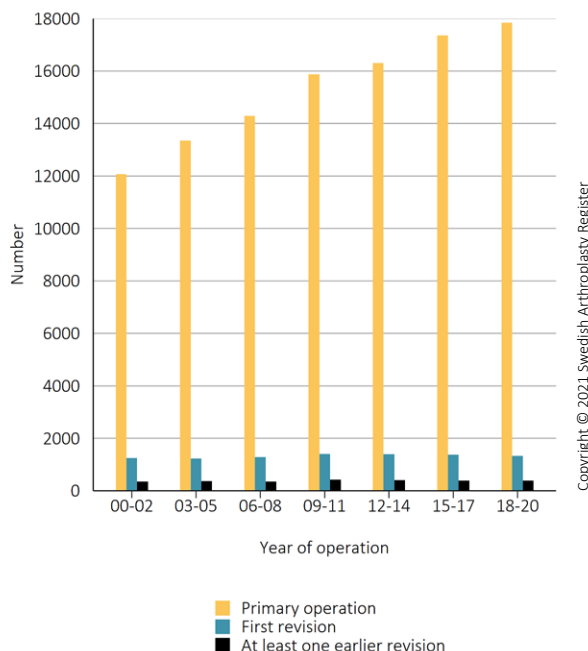


Figure 5.4.2 Number of primary hip replacements, first and multiple-time revisions respectively in 2000–2020. The figure shows the number of replacements as mean per year calculated in three-year periods. The number of primary replacements has increased significantly more than the number of revisions.

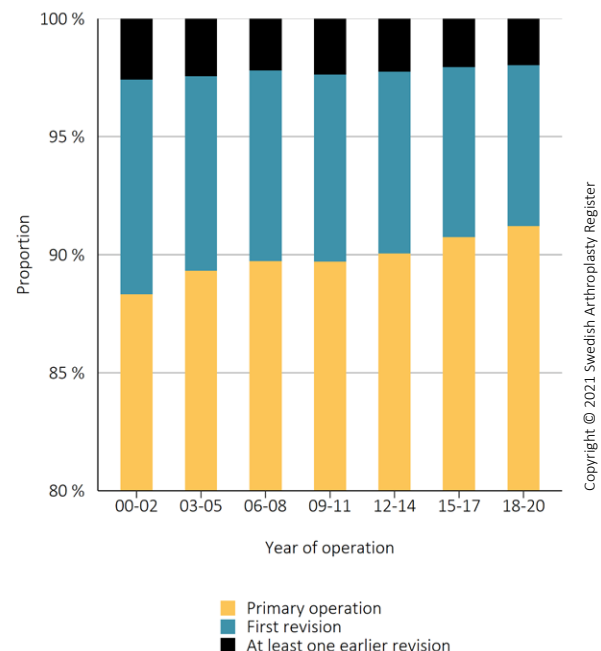


Figure 5.4.3. Proportion of primary hip replacements, first and multiple-time revisions in 2000–2020. The proportion of revisions decreased between the periods 2000–2002 and 2018–2020 from 11.7% to 8.8%.

Demography in first, second and multiple-time revision and primary hip replacement 2011–2020*

	Previous revisions, None, 2011–2020	Previous revisions, one, 2011–2020	Previous revisions, >=2 2011–2020	Primary replacement 2011–2020
Number	13,672	2,882	1,100	170,478
Mean age (SD)	71.79 (11.04)	71.95 (10.77)	71.41 (10.92)	68.82 (10.74)
Age group (%)				
<45	250 (1.8)	42 (1.5)	13 (1.2)	3,447 (2.0)
45–54	748 (5.5)	153 (5.3)	77 (7.0)	13,874 (8.1)
55–64	2,068 (15.1)	418 (14.5)	163 (14.8)	35,359 (20.7)
65–74	4,658 (34.1)	1,002 (34.8)	388 (35.3)	63,916 (37.5)
75–84	4,503 (32.9)	959 (33.3)	347 (31.5)	45,237 (26.5)
≥ 85	1,445 (10.6)	308 (10.7)	112 (10.2)	8,645 (5.1)
Females (%)	7,031 (51.5)	1,376 (47.9)	557 (51.1)	98,917 (58.0)
BMI (%)				
<18,5	154 (1.2)	38 (1.4)	22 (2.2)	1,984 (1.2)
18,5–25	4,143 (32.6)	865 (32.8)	323 (32.3)	54,364 (33.2)
25–30	5,215 (41.0)	1,063 (40.3)	374 (37.4)	68,087 (41.6)
30–35	2,316 (18.2)	473 (17.9)	190 (19.0)	30,336 (18.5)
35–40	683 (5.4)	142 (5.4)	66 (6.6)	7,549 (4.6)
≥ 40	195 (1.5)	56 (2.1)	24 (2.4)	1,371 (0.8)
ASA class (%)				
ASA I	1,409 (10.6)	230 (8.3)	58 (5.5)	35,339 (21.1)
ASA II	7,044 (53.1)	1,373 (49.3)	475 (45.1)	98,680 (58.8)
ASA III	4,570 (34.4)	1,109 (39.8)	498 (47.2)	32,596 (19.4)
ASA IV	248 (1.9)	72 (2.6)	23 (2.2)	1,097 (0.7)
Diagnosis (%)				
Osteoarthritis	10,490 (78.1)	2,052 (73.3)	694 (65.3)	137,749 (80.9)
Inflammatory joint disease	547 (4.1)	206 (7.4)	104 (9.8)	1,466 (0.9)
Acute hip fracture	639 (4.8)	116 (4.1)	45 (4.2)	15,285 (9.0)
Sequele childhood hip disease	446 (3.3)	148 (5.3)	66 (6.2)	3,099 (1.8)
Idiopathic necrosis	302 (2.2)	55 (2.0)	22 (2.1)	4,112 (2.4)
Sequele fracture/trauma	479 (3.6)	112 (4.0)	72 (6.8)	4,176 (2.5)
Tumor	45 (0.3)	11 (0.4)	6 (0.6)	829 (0.5)
Other secondary osteoarthritis	381 (2.8)	62 (2.2)	29 (2.7)	3,130 (1.8)
Acute trauma, other	52 (0.4)	17 (0.6)	10 (0.9)	374 (0.2)
Other joint diseases	54 (0.4)	19 (0.7)	14 (1.3)	143 (0.1)

Table 5.4.1. Age, sex, BMI, ASA class and diagnosis in first, second and multiple -time revisions from 2011. Corresponding variables are shown for primary hip replacements for comparison.

*Two step procedures is considered as one revision.

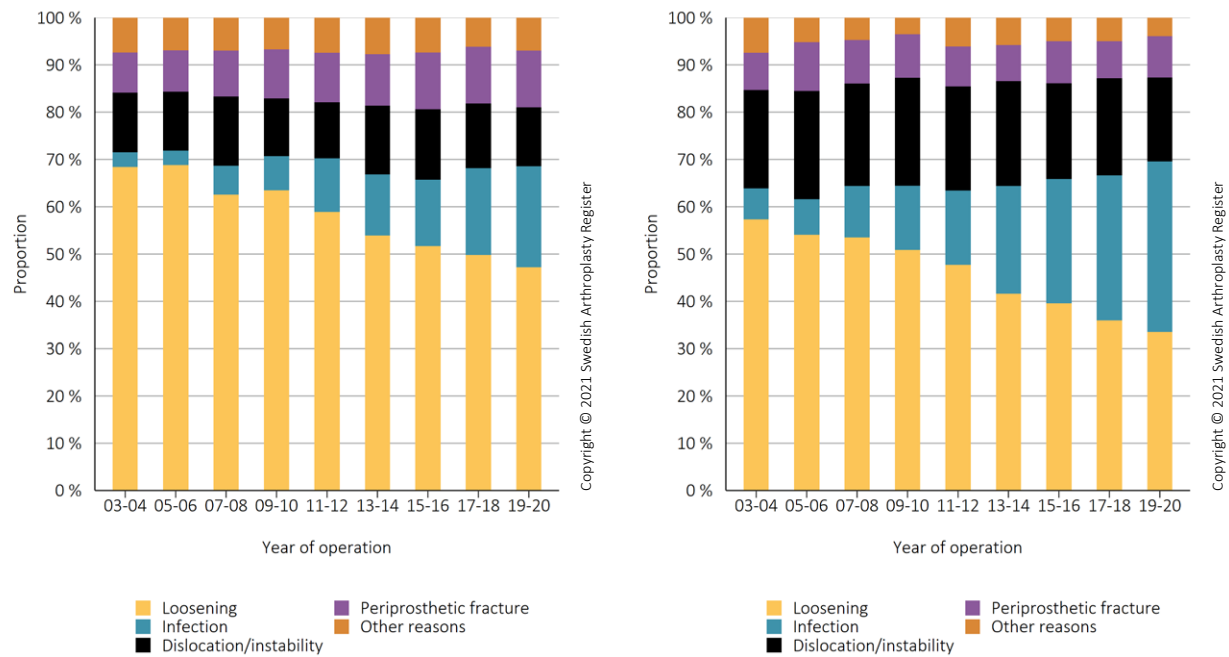


Figure 5.4.4. Distribution of reasons for revision in first (a) and multiple-time revisions (b) in three-year periods between 2000 and 2020 regardless of sex.

Some of the units that report 10 or fewer revisions per year may have problems with poor reporting, but in the majority of cases the reported number should be correct. In total, these hospitals have performed 128 revisions in 2020, in most cases due to infection (n=48), dislocation (n=43) or loosening (n=22). Change of femoral head, cup and/or liner were the most common procedures (n=109). In the other cases the stem was changed or extracted with or without change/extraction of the cup.

In summary, the number of hospitals with small revision volumes has been relatively constant. We think that it is advantageous to maintain a certain volume of revisions not least as the balance between correct indications and choice of treatment may be difficult. The prevalence of peroperative complications is higher than in primary surgery and unexpected findings and events in revision surgery is more common. These cases call for experienced and for the purpose trained personnel and access to special instruments, bone bank and a sufficiently large assortment of implants.

In figures 5.4.5 and 5.4.6 the distribution of primary replacements and revisions per unit in the group total prosthesis is given in 2019 and in 2020. The total num-

ber of these operations is also given to be able assess the relevance of percentage distribution.

Reason for revision

Between 2003 and 2020 aseptic loosening (55.5%), dislocation (15.0%), infection (12.7%) and periprosthetic fracture (10.2%) have been the most common reasons for revision regardless of previous revision or not. Over time the distribution of causes has however changed (figures 5.4.4a and b). In first-time revision 68.4% of the operations performed in 2003–2004 were caused by loosening, osteolysis and/or wear which also are included in this group. Dislocation came second (12.5%), followed by periprosthetic fracture (8.5%) and infection (3.1%). Multiple-time revisions in the same time-period, the proportion of revisions due to infection and dislocation are above all higher at the expense of decreasing number of revisions due to loosening (loosening: 57.9%, dislocation: 20.8%, infection: 6.5%, periprosthetic fracture: 7.9%). Until the period 2019–2020 this distribution changed successively in both groups. In first-time revision, loosening is still dominating, but has been reduced to 47.2%, followed by infection (21.3%), dislocation (12.4%) and periprosthetic fracture (12.1%). Deep infec-

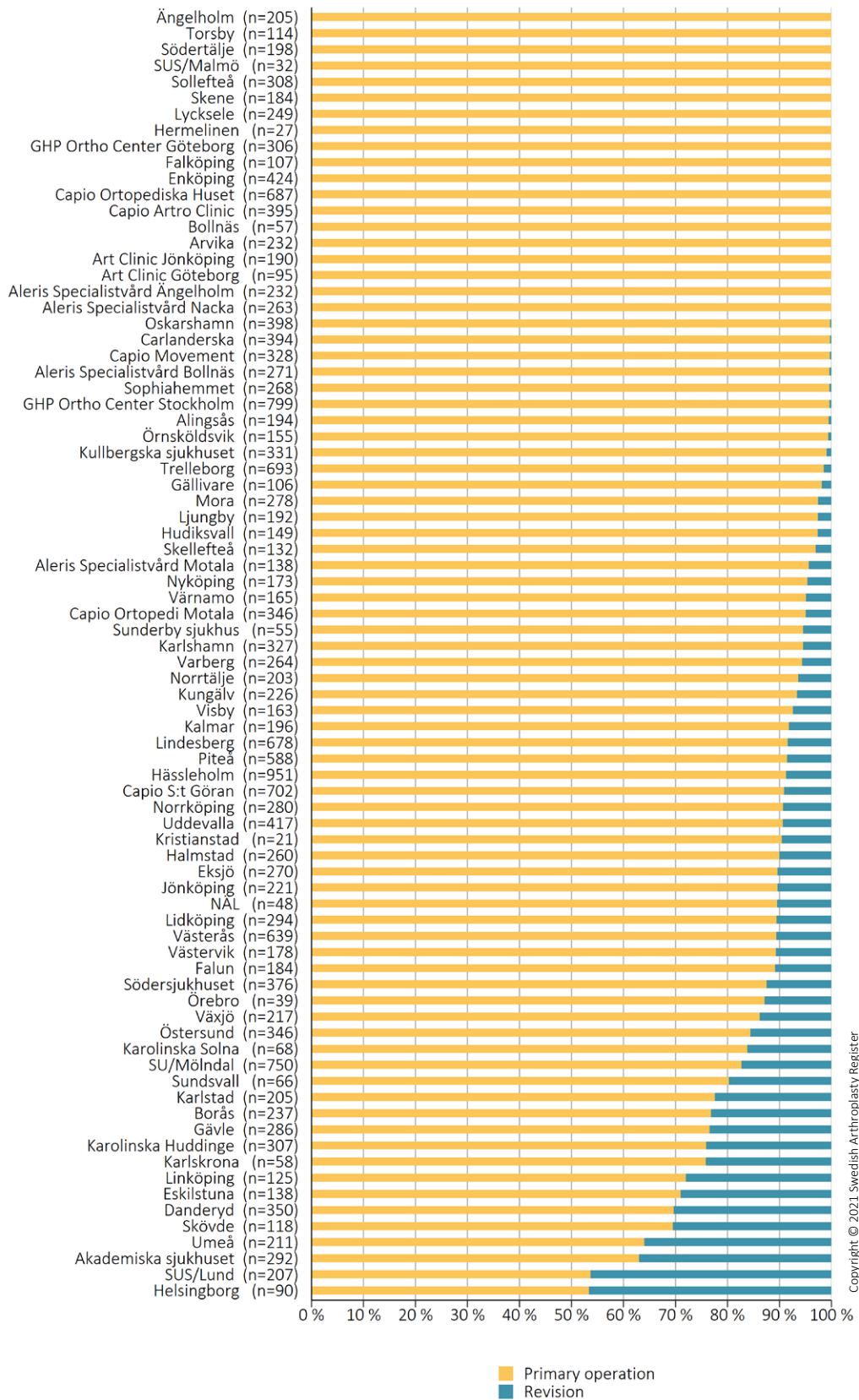


Figure 5.4.5. Distribution of primary total hip replacements and revisions of total hip replacements per unit in 2019. Total number of primaries and revisions are shown to the left.

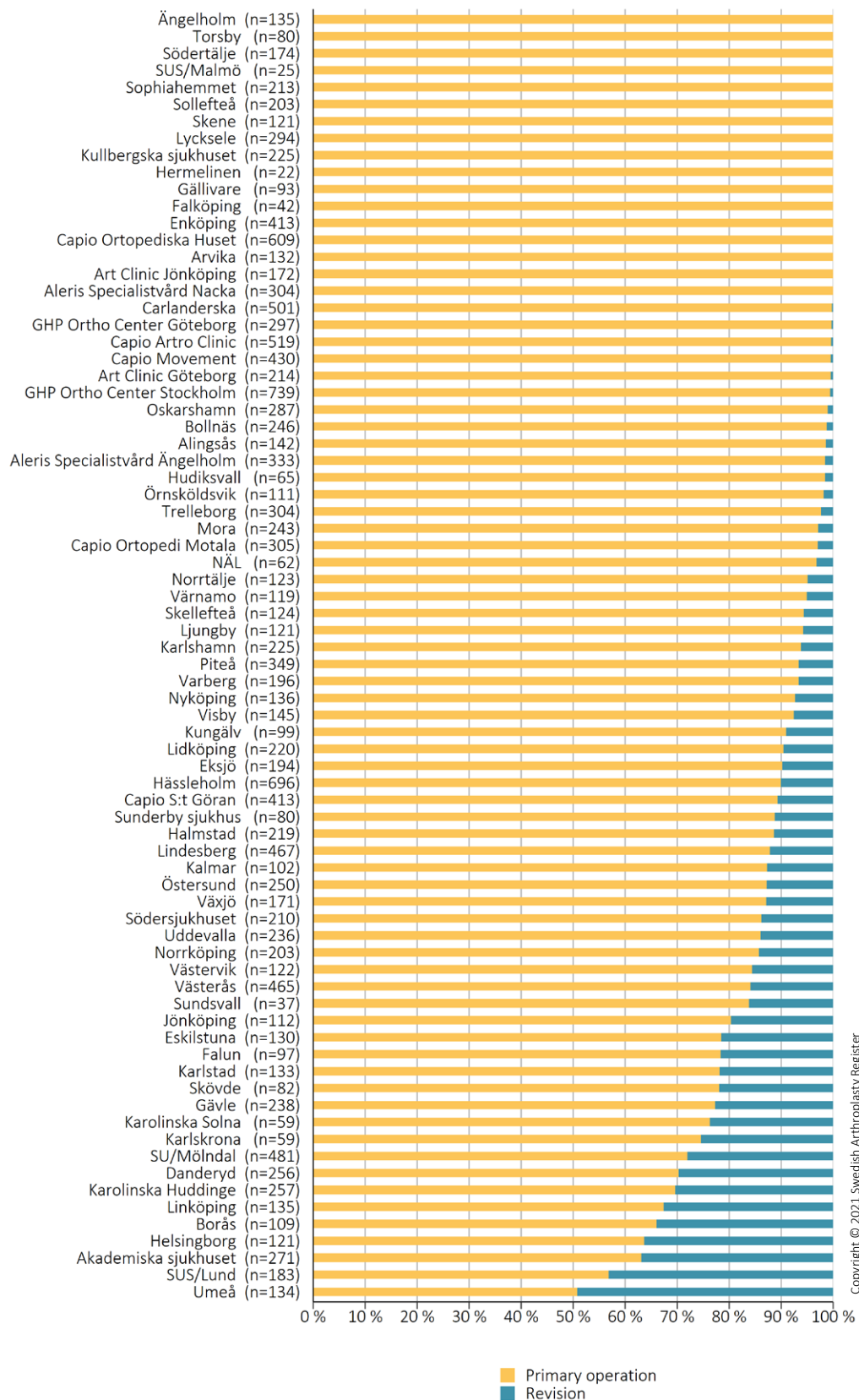


Figure 5.4.6. Distribution of primary total hip replacements and revisions of total hip replacements per unit in 2020. In the last seven years, the number of units that only perform few revisions of total replacements have been relatively unchanged. If hemiarthroplasties are added, the distribution changes marginally. Total number of primaries and revisions are shown to the left.

tion was the most common reason in multiple-time revision in the period 2019–2020 (36.0%), followed by loosening (33.5%), dislocation (17.8%) and periprosthetic fracture (8.7%). The total number of revisions due to loosening regardless of if it is first-time or multiple-time revision decreased from between 948 and 1,022 in the years 2003 and 2006 to between 605 and 795 per year in the period 2017 to 2019. In corresponding periods of time, a most substantial increase of revisions due to infection is seen from 49 to 67 during the first period to between 330 and 391 per year during the last period. For the reason dislocation, the change is marginal with an interval of 182 to 248 per year during the early period to between 191 and 267 during the last four years. For periprosthetic fracture a tendency of increase in numbers can be seen, from 117 to 134 in the early time interval to between 173 and 188 during the latest time interval.

In general, the distribution of the four most common groups of reason of revision loosening/osteolysis/wear, infection, dislocation and periprosthetic fracture thus differs between first-time and multiple-time revisions. There is also a sex related difference. In the last five years the relative proportion of males that have been revised due to deep infection and periprosthetic fracture (26.5 and 12.4% respectively) has been larger than the corresponding proportion of females (17.0 and 10.0% respectively). Instead, females have been revised more often due to loosening, dislocation, and other causes (females/males: 48.4/43.6%, 17.5/11.9%, 7.1/5.5%, regardless if a previous revision has been performed or not).

In the group other reasons for revision several different diagnoses and procedures are hiding. Several of them are also treated surgically without implant change or extraction why chapter 5.2 (table 5.2.2) and the chapter “Uncommon reasons for reoperation” in the annual report 2018 give a better overview.

Stem fracture

Stem fracture is an unusual complication. In the Swedish Arthroplasty Register, stem fracture is however, not registered as specific cause but is classified as implant fracture. Exact information is thus missing regarding which component or components that have been affected. In table 5.4.2 we have defined those operations where a primary operation has been revised or a revision has been re-revised with stem revision due to implant fracture. The table gives total number of reported stems of a specific design, the number that has been reported being revised due to

implant fracture divided into primary and revision cases and proportion with fracture in percentage of the total number. In the column to the far right, we have tried to define how many of the implant fractures that affect the smallest stem size that is recorded in register. In some cases, however, information is missing for some (for example SP dysplasia) or for all the implants of a specific design why this data has been omitted or stated as the least confident proportion.

Six stems show a fracture frequency of around one percent or more. Three of them (MP custom-made, Reef and ZMR) have only been used in few cases, why it is not possible to draw any conclusions. Regarding the remaining three, the observed number for SP dysplasia is low ($n=59$) while Exeter's short revision stem has been used in 901 and Revitan in 1,084 primary or revision operations. In these cases, the prevalence of implant fracture is at least 10 times higher than for the cemented and uncemented group respectively overall. If one assumes that the 27 fractured stems with missing data on stem design is distributed between cemented and uncemented fixation in the same way as in the group with identified implants and in addition, adds the implant types where there is not any stem fracture at all reported to the total number of observations, the incidence of stem fracture changes marginally. For cemented stems, it increases from 0.09% to 0.10% and for uncemented stems it decreases from 0.06% to 0.05%. The lower incidence for uncemented fixation may depend on the fact that cemented stems are thinner to give room for cement, longer observational time, as well as some design-specific problems, for example regarding size 01 of the SP II-stem.

The SP II-stem shows an incidence of 0.08% which means that the number of implant fractures correspond to the average. If one instead relates the result to stem size, it shows that 94 out of the 114 implant fractures were of size 01, 11 had size one, seven size two and the other two affected even bigger sizes. This means that the incidence is 8–9 times higher than the average for size 01, for size 1 it is less than half the average and for size 2 four times lower.

In general, thin stems of certain models should be avoided for younger active patients with a narrow marrow cavity. We hope that this review can be of some help, at least regarding designs that should be avoided. Regarding best choice, specific recommendations cannot be given apart from that well-documented stems of size and model that show the lowest frequency in table 5.4.2 or that are not there at all should be used. It should however be noted

Stems inserted 2000–2020 and revised due to implant fracture (n=286)

	Number inserted 2000–2020 ¹	Fracture of primary/revision prosthesis	Proportion with implant fracture percent ²	Smallest size/other stem sizes* Number with implant fracture
Cemented				
Charnley	4,681	3/0	0,06	-
CPT	3,787	1/4	0.13	0/5
Durom	381	1/0	0.26	-
Elite Plus	922	1/0	0.11	0/1
Exter short revision stem	901	1/9	1.11	-
Exter long	1,497	1/3	0.27	0/4
Exeter standard	69,879	48/12	0.09	23/37
MP custom-made	2	0/1	50	-
MS-30 polished	17,920	7/2	0.05	2/7
Müller straight	907	1/0	0.11	-
Spectron EF Primary	9,408	11/0	0.12	8/3
SP II Dysplasi	59	2/1	5.08	≥1/≤2
SP II standard	134,674	99/15	0.08	94/20
Uncemented				
Bi-Metric X por HA NC	9,424	5/0	0.05	0/5
CFP	464	1/0	0.22	1/1
CLS	14,485	6/0	0.04	0/6
Corail high offset	6,878	1/0	0.01	-
Corail Revision	249	0/1	0.40	≥0/≤1
Corail standard	22,418	6/1	0.03	0/7
MP	3,441	0/3	0.09	≥1/≤3
Reef	24	0/1	4	1/1
Restoration	1,574	0/1	0.06	0/1
Revitan	1,084	0/7	0.65	1/6
Wagner Cone	2,372	2/0	0.08	0/2
ZMR Taper	10	0/1	10	0/1
Missing	-	0/27	-	-
All cemented/uncemented	245,018/62,422	223/36	0.09/0.06	-

Table 5.4.2. Revised stems due to implant fracture after primary replacement or revision (regardless of number of previous revisions) 2000–2020.

*Minimum size and diameter registered by SLR. # Primary and revision prosthesis.

- Information on stem size completely or partially missing or is not relevant. Several of the groups include different stem lengths.

that a stem fracture is not a completely avoidable complication and the more often a stem is used the higher the probability is that at least few stem fractures will occur. When assessing stems that are not in the list, the number of used stems and observational time for the stem in question thus must be considered.

Reason for re-revision related to previous reason for revision

The reason why a patient is revised for the first time affects the cause profile in a possible second revision (table 5.4.3). A patient who undergoes a first revision due to loosening/osteolysis, infection or dislocation has a high probability to be revised due to the same reason at a possible second revision. The same can be said of patients affected by a second-time revision. An exception is patients who

are operated on for a periprosthetic fracture at the first revision. In these cases, the most common reason for any subsequent revision is dislocation followed by loosening and infection, both after first- and second-time revisions. This year, primary and revision operations performed between 2002 and 2020 are presented. As in the annual report of the previous year, complete and partial prosthesis extractions where a second procedure (session 2) has not been registered are presented. In these cases, one can, based on dates of prosthesis extraction assume that most patients who undergo prosthesis extraction in the three to six last months of 2020 are scheduled to undergo prosthesis insertion in the beginning of 2021. Of the 956 “definitive” partial or total prosthesis extractions that are reported starting in 2002, 52 (5.4%) were performed in the period July to December 2020. The majority of these will most likely undergo step two in 2021 and may

Reason for revision related to the previous one

	Loosening	Infection	Periprosthetic fracture	Dislocation	Other/missing
Primary replacement 2002–2020 n = 297,746					
First revision, %	1.5	1	0.5	0.8	0.3
No revision	95.9				
First revision 2002–2020 n = 25,100					
No reported insertion	1.2	7.7	1.4	3.2	2.7
Loosening	5.7	1.1	2.8	1.9	3.9
Infection	1	8.7	1.9	3.1	3.1
Periprosthetic fracture	1.1	0.4	0.9	0.8	1.1
Dislocation	2.2	1.2	3.4	6.8	3.6
Other/missing	0.7	0.5	0.8	0.5	1.4
No re-revision	88.1	80.5	88.8	83.6	84.2
Second revision 2002–2020 n = 5,305					
No reported insertion	1.8	10.5	1.8	4.2	3.7
Loosening	7	0.9	5.2	2.9	3.7
Infection	1.4	8.8	2	2.9	4.7
Periprosthetic fracture	1.1	0.4	0.9	1.4	0.5
Dislocation	3.3	2	6.5	9	5.7
Other/missing	0.9	0.6	1.1	1.1	1.4
No re-revision	84.5	76.8	82.5	78.6	80.4

Table 5.4.3. Distribution of reason for second and third revision respectively in percent, related to the reason for any preceding revision. Primary replacements and revisions between 2002–2020 are included. The group loosening includes osteolysis and wear. For two-staged revisions, the reason that were relevant for the first stage (extraction) is stated. Prosthesis extraction that is not followed by insertion is presented in a separate group. For a smaller proportion of these, insertion of a prosthesis may be planned in 2021. Percentage indicating the most common reason for re-revision in bold.

be misclassified in table 5.4.3. They make up a relatively small proportion of all extractions and all will likely not be inserted with a prosthesis. Nevertheless, the proportion of “definitive” extractions in the table should be somewhat decreased.

Prosthesis extraction without subsequent insertion of a new prosthesis

Between 2000 and 2019 the proportion of revisions that meant definitive complete or partial prosthesis extraction amounted to 1.9% (average: 26 per year) among the first-time revisions and 5.9% (23 per year) among those multiply revised. Per three-year period the total number has varied between 129 and 172 (figure 5.4.7). The most common reason in the period 2000 to 2020 was deep infection (first-time/multiple revision: 54.1/65.9%) followed by dislocation (22.8/21.2%) and loosening (12.4/8.7%). In the period there was a gradual increase of definitive extractions due to infection and at the same time the cause groups loosening and to an even greater extent dislocation decreased. In 2019 and 2020 infection as reason constituted 74.1% of all extractions in first-time revision. The corresponding proportion in multiple-time revision was larger (81.4%). In the same period, loosening, and dislocation as reason accounted for between

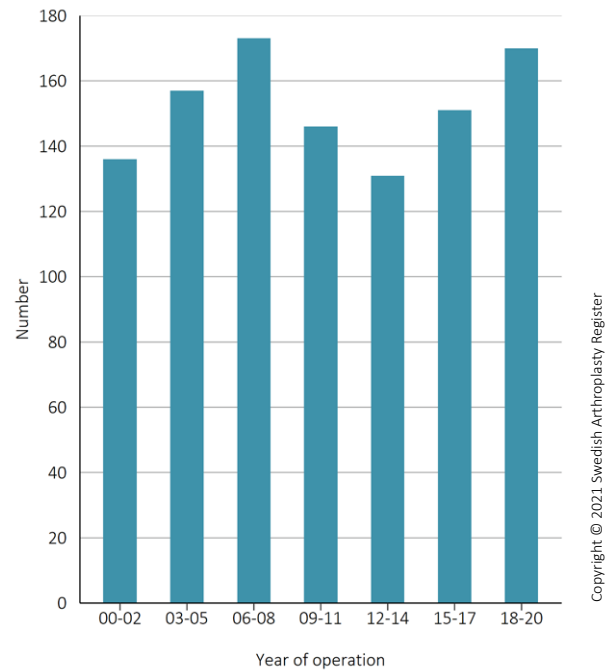


Figure 5.4.7. Number of total and partial extractions per three-year periods where there is no report of a subsequent insertion of a new prosthesis or prosthesis component(s).

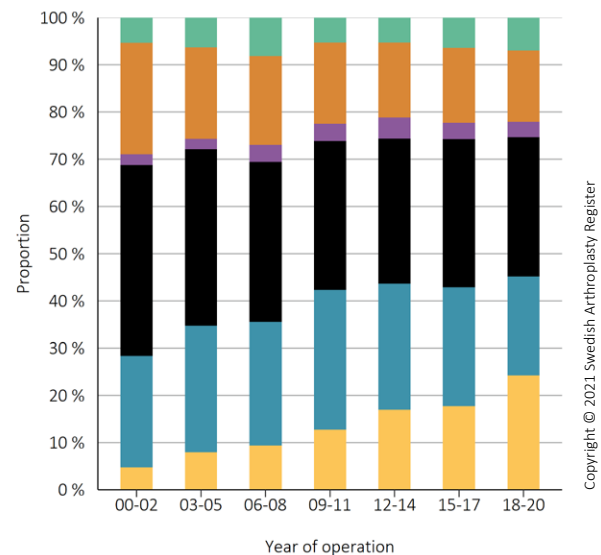
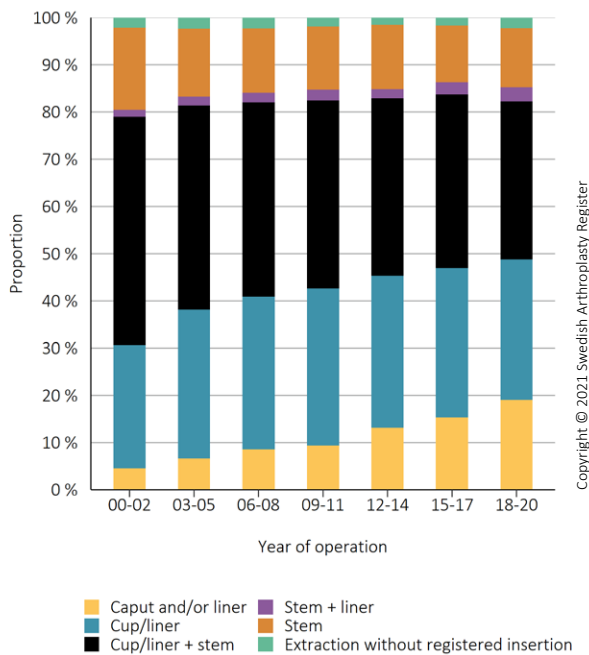


Figure 5.4.8. Relative distribution of procedures in first (a) and multiple-time revision (b) in three-year periods 2000–2020.

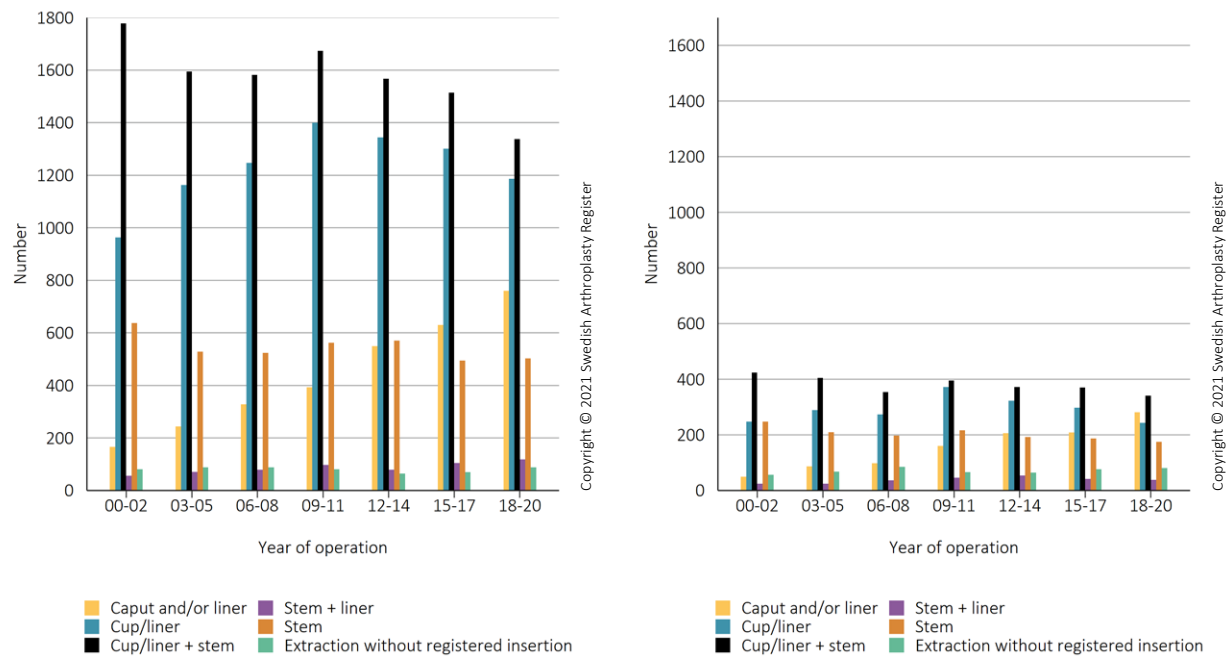


Figure 5.4.9. Number of reported procedures in first (a) and multi-time revision (b) in three-year periods 2000–2020.

5.1 and 8.6% regardless of the number of previous revisions. The remaining proportion (8.6/6.8%) were caused by periprosthetic fracture. The mortality among patients with extracted prosthesis is high, which is expected against the background of that they mainly consist of cases with difficult-to-treat infection, periprosthetic fracture or dislocation and furthermore have high comorbidity. Half of the patients that have been operated from 2000 and onwards live without a hip prosthesis for slightly less than three years (median 2.7 years) and only slightly more than 9% for 10 years or longer.

Type of procedure at revision

Change of both cup and or liner and stem has been the most common type of procedure at both first-time and multiple-time revision since 2000 (figures 5.4.8a and b). This measure has however tended to decrease in both these groups. Change of femoral head and or liner has increased during the whole period, probably as an effect of an increasing number of DAIRs (Debridement Antibiotics Implant Retention). Nor is it unexpected that the proportion of extraction without registered insertion make up a considerably larger part of the multiple-time revisions than of the first-time revisions. There are however somewhat more permanent prosthesis extractions

carried out measured in absolute numbers during first-time revision than during multiple-time revision (figures 5.4.9a and b).

Choice of procedure related to reason for revision

Type of procedure varies depending on the reason for revision. Here, just as in other places of this section, the heading change/insertion means that the patient may have undergone a two-session procedure. Extractions followed by a registered prosthesis insertion have thus been excluded. In figures 5.4.10a and b the relative distribution of procedures related to reason for revision in first-time and multiple-time revisions performed 2015 to 2020 are illustrated. In first-time revisions due to aseptic loosening cup/liner combined with stem change dominates, closely followed by cup/liner changes. In multiply revised cases it becomes relatively more common that only one of the components are revised. In cases with deep infection femoral head and/or liner changes dominate during both first-time and multiple-time revisions, and as expected the relative proportion of definitive extractions increases substantially if the hip prosthesis is revised at least once earlier. The majority of periprosthetic fractures is as expected to become revised with stem change. A concur-

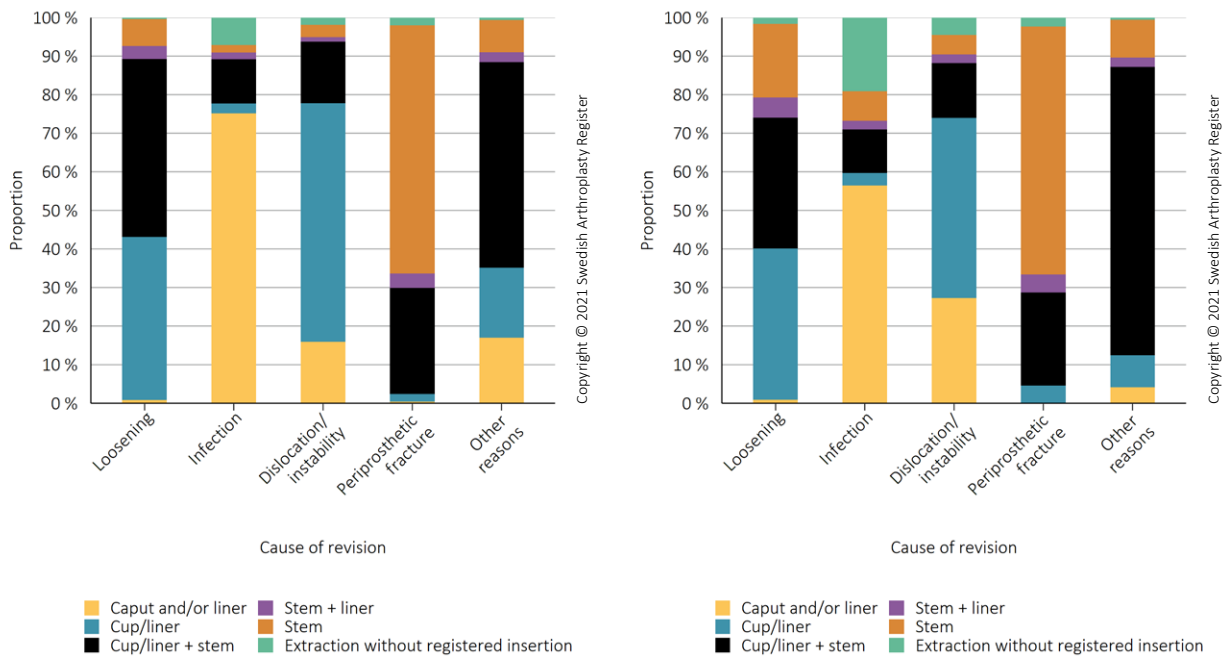


Figure 5.4.10. Relative distribution of procedure per reason for revision in first (a) and multiple-time revision (b) 2015–2020.

rent change of cup/liner is performed in just under every fourth case. The most common measure in first-time revision due to dislocation is cup/liner change with or without change of stem (78.0%, of which 19% is change of only liner). In multiple-time revision, this proportion decreases to 60.9% (of which 30% is liner change) since more cases only undergo change of femoral head and liner.

Choice of fixation

Just as for primary operations, the number of revisions with uncemented cup increases. The increase of the proportion of uncemented cups was noticeable until the period 2009 to 2011 (figures 5.4.11a and b). Hereafter the use of uncemented cup has remained relatively constant while cemented fixation has continued to decrease, especially in first-time revision. On the stem side similar pattern is seen, but here a plateau is apparently reached after the period 2009 to 2011 in first-time revision and already after the period 2003 to 2005 in multiple-time revision where after the number of stems fixated with cement is relatively constant until the period 2018 to 2020 (figures 5.4.12a and b). In first-time revision the number of inserted uncemented stems decreases from the period 2012 to 2014 and onwards which reflects the trend over the whole period. In the period 2000 to 2002

in total 4,736 cemented and uncemented stems were inserted in first-time revision and 1,287 in multiple-time revision. In the last period 2018 to 2020 the corresponding numbers were 2,850 and 813 respectively, possibly due to a decreasing need of stem change due to loosening.

In revision surgery the notions of completely cemented, completely uncemented, hybrid and reversed hybrid become less relevant, since one often only changes part of the prosthesis. This means for example that a prosthesis which after revision is classified as hybrid may still have one or more “original parts” alternatively make up a completely new prosthesis if all parts have been changed. In the period 2000–2020 all components were changed in 39.7% of all first-time revisions and in 31.0% of all multiple-time revisions including insertion at stage 2 in 2-stage procedures (figures 5.4.13a and b). Between 2000 and 2003 both components were cemented in most cases. Hereafter there is a successive increase of combinations where at least one uncemented component is included and especially of completely uncemented fixation except from the latest three-year period when hybrid fixation becomes the most common in first-time revision, while completely uncemented fixation remains the most common method in multiple-time revision.

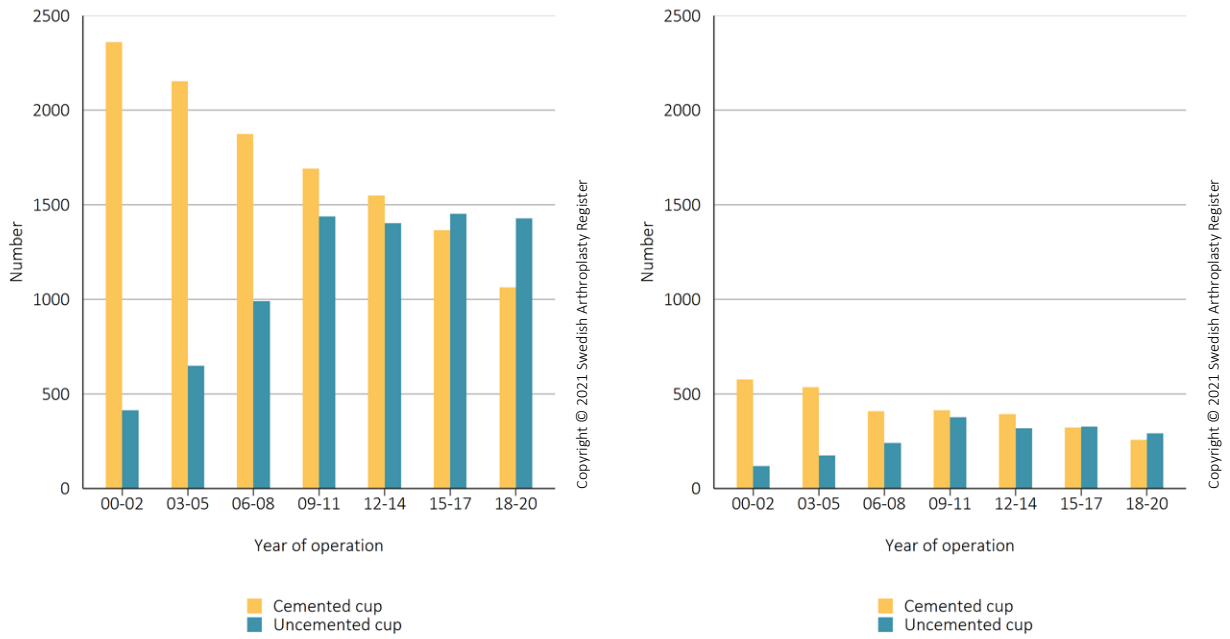


Figure 5.4.11. Distribution of cemented and uncemented fixation respectively of the cup in first (a) and multiple-time revision (b) in three-year periods 2000–2020.

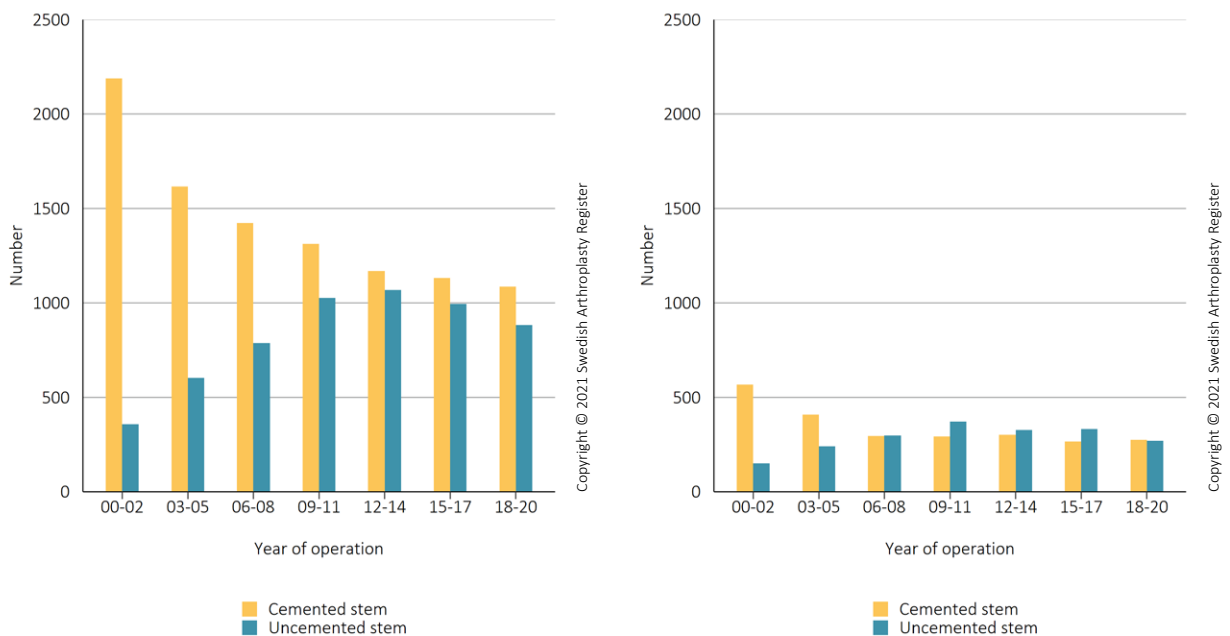


Figure 5.4.12. Distribution of cemented and uncemented fixation respectively of the stem in first (a) and multiple-time revision (b) in three-year periods 2000–2020.

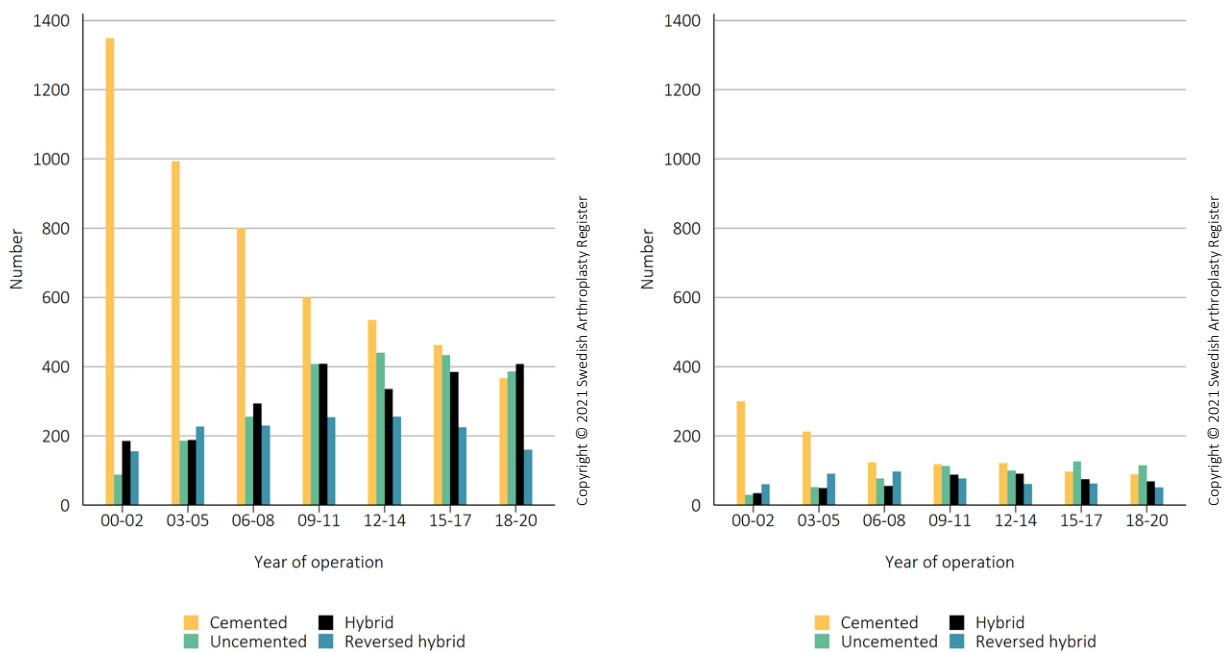


Figure 5.4.13. Distribution of completely cemented, completely uncemented, hybrid and reverse hybrid fixation in cases where all components were exchanged in first (a) and multiple-time revision (b) in three-year periods 2000–2020.

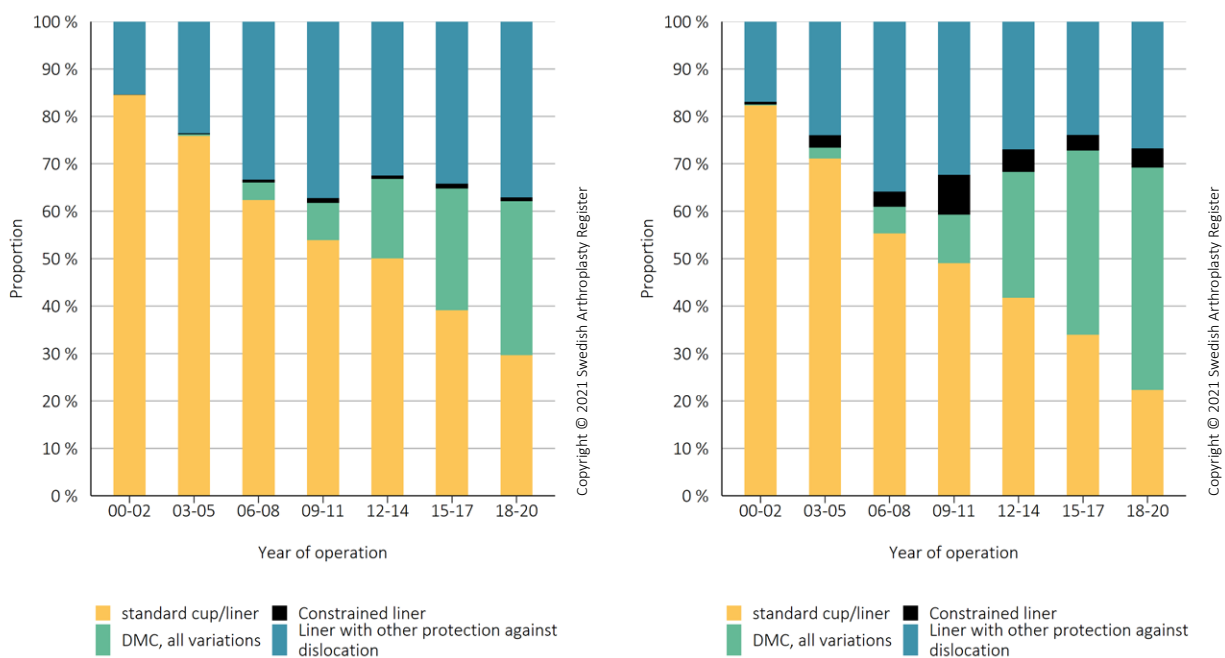


Figure 5.4.14. Distribution of cup or liner constructions in first (a) and multiple-time revision (b) in three-year periods 2000–2020 used to protect against dislocation.

Choice of cup and liner

Over the last two decades the use of cup and liner constructions that are designed to reduce the risk of dislocation has become more common (figures 5.4.14 a and b). Initially this “dislocation protection” constituted use of a liner with an acetabular wedge augment or partially elevated rim, increased inclination, or a similar modification. Another option is plastic inlays that lock the femoral head, “constrained liner” which is only used in a limited number of cases, maybe due to varying clinical results in the literature. Dual mobility cups (DMC) were reported the first time in 2002 (one case) and has since been used in increasing numbers. In the period 2018 to 2020 DMC was used during almost every third first-time cup revisions (32.5%) and in just under half (46.5%) of all multiple-time revisions with cup change or at insertion after an earlier extraction. The majority of these were fixated with cement (77.6% regardless of the number of earlier revisions).

Choice of femoral head

Femoral heads are changed routinely during almost all revisions. From 2000, there is information on inserted femoral head in 89.2% of all first-time revisions and in 86.3% of all multiple-time revisions. In other cases, the femoral head has not been changed or an eventual change has not been reported. If one also excludes the DM cups where the size of the inner femoral head does not affect the stability of the joint in the same way, 88.8% remain in first-time revision (n=22,353) and 85.0% (5,932) of the multiple-time revisions. Figures 5.4.15 a and b illustrate how choice of femoral head size has changed since the period 2000 to 2002 in first-time revision and in multiple-time revision. Over time there is a shift to 32 and 36 mm as an effect of the introduction of wear-resistant polyethylene with extra crosslinking and the wish to reduce the risk of dislocation. In the last three-year periods the relative proportion of 36 mm heads has stabilised and the use of femoral heads with a larger diameter than 36 mm has almost stopped. (For an overview see Tsikan-dylakis et al. EFORT Open Rev. 2018 May 21;3(5):225-231. doi: 10.1302/2058-5241.3.170061. and EFORT Open Rev. 2020 Oct 26;5(10):763-775. doi: 10.1302/2058-5241.5.200002.)

Choice of stem

Between the period 2000 to 2002 and the period 2018 to 2020 the number of operations with change/insertion of stem has gradually decreased. In the first period it was

824 and 232 operations (first time/multiple-time revision) respectively per year. In the last period the numbers had decreased to 652 and 185 per year respectively.

In first-time revision, cemented fixation has dominated but successively decreased until the period 2012 to 2014 and thereafter increased marginally. In multiple-time revision, the same pattern can be seen with the difference that the increase is seen only in the most recent period, 2018 to 2020.

When cemented fixation is used, stems of standard type dominate and in uncemented fixation, stems with a separate distal and proximal part, two-part stem is the most common choice. In the period 2018 to 2020 the use of this stem type has decreased somewhat benefitting cemented fixation in both first-time and multiple-time revision (figures 5.4.16 a and b). Transplantation of bone from bone bank is reported in 30.2% of the cases in cemented fixation regardless of first-time or multiple-time revision with a tendency to decrease between 2000 to 2002 and 2018 to 2020 (from 35.2 to 21.2% of cases). These data are subject to some uncertainty but argues against that the bone impaction technique has increased in use. Rather it is an increased number operated with standard cementation and possibly also of re-cementation of a stem into the old cement mantle (cement-in-cement technique).

Choice of specific implant

Table 5.4.4 shows the most used cemented and uncemented cups and stems in 2010, 2019 and 2020. This is a rolling schedule that is updated annually. Since the information on stem length is not complete, all SP II-stems and Exeter-stems have in standard version brought together in separate groups. Exeter short revision stem is reported separately since its results regarding risk for stem fracture differs from other stems within the same family.

Cemented dual mobility cup has during the last years been frequently used in revisions. In 2020 DM-cups of different brands accounted for 43.1% of the total number of cemented revision cups. Furthermore, it was reported 69 operations where a DM-cup has been cemented in an uncemented shell (mainly TMT revision), except 21 DM-cups intended for uncemented fixation. How these three different ways of fixating a DM-cup distribute over time is shown in figure 5.4.17. By far the most used DM-cup is Avantage also in cases where a DM cup is cemented into an uncemented cup shell.

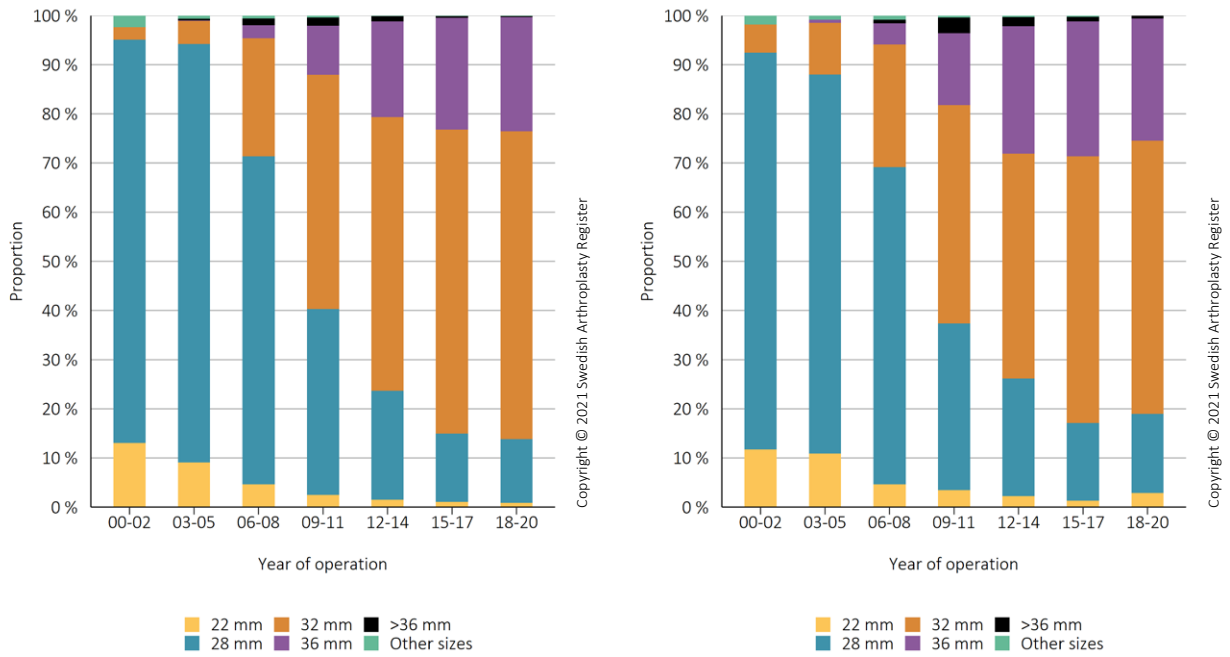


Figure 5.4.15. Choice of femoral head size in first (a) and multiple-time revision (b) in three-year periods 2000–2020.

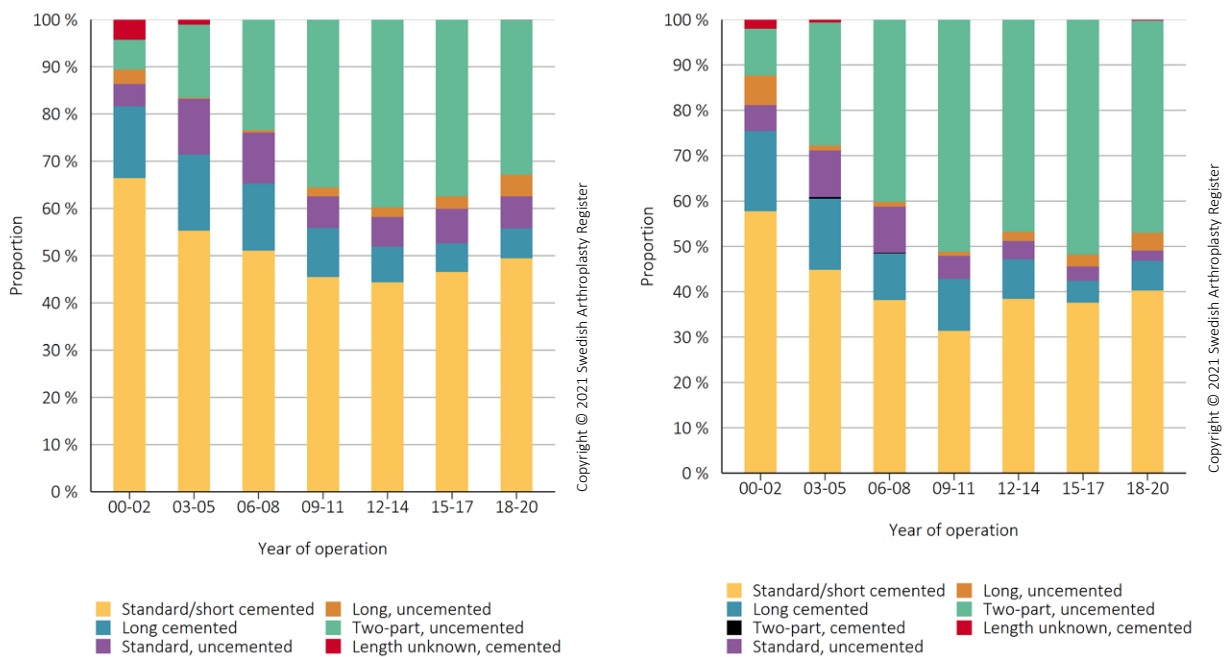


Figure 5.4.16. Distribution of cemented and uncemented types of stem respectively in first (a) and multiple-time revision (b) in three-year periods 2000–2020. The stem is defined as long if the length exceeds 150 mm.

Most used cup and stem

2010		2019		2020	
Name	Percent	Name	Percent	Name	Percent
Cup, Cemented, n	703		446		383
Lubinus	16.8	Avantage	36.8	Avantage	32.1
Marathon	14.4	Exeter Rim-fit	20	Exeter Rim-fit	20.4
Avantage	11.4	Lubinus x-link	15.5	Lubinus x-link	19.3
Contemporary Hoded Duration	11	Marathon	13.2	Marathon	10.4
ZCA XLPE	10.5	Polarcup cemented	6.7	Polarcup cemented	9.1
Other	35.9	Other	7.8	Other	8.7
Cup, uncemented, n	607		602		504
Trilogy	31	TMT revision	27.7	TMT revision	25.6
TMT modular	18.9	Tritanium revision (trident)	18.3	Tritanium revision (trident)	20.1
TMT revision	18.3	Continuum	11.6	Pinnacle 100	8.4
Continuum	7.7	Pinnacle W/Gription 100	8.1	Continuum	7.6
Trident AD LW	5.9	Trilogy IT	5.3	Pinnacle W/Gription Sector	6.4
Övriga	18.2	Other	29	Other	31.9
Stem, Cemented, n	482		448		383
Exeter standard	27.2	Exeter standard	41.7	Exeter standard	38.6
SPII standard	25.1	SPII standard	32.1	SPII standard	35.5
Exeter short rev stem	14.3	Exeter short rev stem	8.3	Exeter short rev stem	7.3
CPT long rev	7.7	Exeter long	6.9	Exeter long	7
Exeter long	7.7	CPT	4.2	MS30	3.1
Other	18	Other	6.8	Other	8.5
Stem, Uncemented, n	499		419		354
MP	47.3	MP	37.2	Restoration	31.9
Restoration	21.4	Restoration	28.2	MP	31.4
Revitan cylinder	10.2	Arcos	8.4	Corail revision	11
Wagner SL Revision	4.4	Corail revision	8.1	Arcos	6.5
Corail standard	2.8	Revitan cylinder	6.2	Revitan cylinder	5.9
Other	13.9	Other	11.9	Other	13.3

Table 5.4.4. The five most used cemented an uncemented cup and stems in revision surgery presented as percent of the total number of reported in 2010, 2019 and 2020. Both first and multiple-time revisions are included.

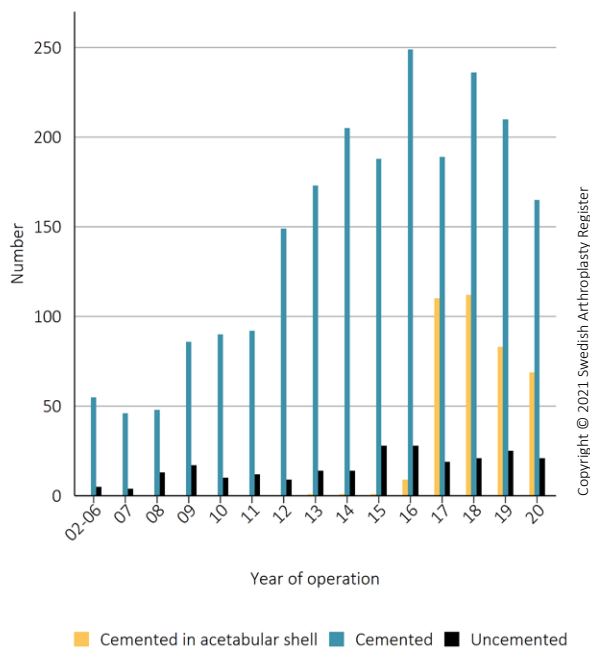


Figure 5.4.17. Number of reported dual morbidity cups fixated with cement, without cement or cemented into the acetabular shell regardless if first or multi-time revision.

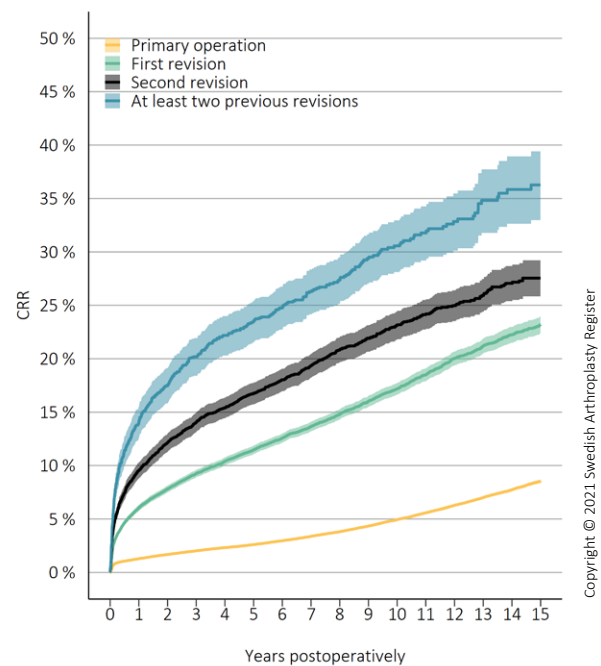


Figure 5.4.18. Cumulative risk of revision up to 15 years including both sexes based on revision regardless reason or type of procedure in primary total hip replacements, first and second time revisions and in revisions of hip replacements with at least two previous revisions. Revisions from 2000 to 2020 are included.

The two most used uncemented cups (TMT revision, Tritanium revision) have had the same placement in 2019 and 2020. The placement of subsequent brands has changed but since it is a relatively small number, no major changes are needed for the placement to changes. It is still an interesting observation that Pinnacle 100, in 2020 ended up in the third place (8.4%, n=43) from that the year before have only been used in 5 revision cases, not at least when there is no evidence that uncemented cups with a trabecular metal surface such as Pinnacle Gription (on 5th place) would bring some benefits.

Different variations of Exeter and Lubinus SP II stems dominate when choosing cemented fixation throughout the period. Compared with the two previously reported years 2010 and in 2019, the MS30 was replaced by the CPT stem. The number however, reported MS30 stems is limited (n=12) and slightly lower than CPT (n=14) if the numbers of standard and long revision stems are added up in one group. In 2020, 148 cement-in-cement revisions were performed (38.6% of all revisions with a cemented stem). In 54.9% of the cases an Exeter stem was used, in 22.1% and 6.1% respectively Lubinus SP II and MS30 stem and in other cases CPT or Spectron EF Primary.

Among uncemented revision stems the same implants which were the five most used implants in 2019 remain though their mutual order has partly changed. Restoration has become more popular and was in 2020 the most used. Corail revision has also increased and has advanced from fourth to third place. In the register, it is noted if bone from a bone bank has been used during stem revision. However, it is not registered in which way, as this information is difficult to obtain from the medical records. In 69 cemented and 22 uncemented stem revisions (18% and 6.3% respectively) bank bone was used and probably this means, at least in most of these cemented cases, that an impaction grafting has been performed. In these cases, some type of Exeter stem (n=39), Lubinus SP II (n=27) or CPT (n=3) was used. In the uncemented group, mainly Corail revision (n=7) or Restoration (n=7) were used. The other eight cases were distributed in six different uncemented cement types.

Just as in primary replacement surgery, the conformity is in Sweden regarding the choice of implant greatest for cemented fixation. The size of the group "other" for each fixation group respectively gives a certain but limited perception of how diversified the choice of implant is,

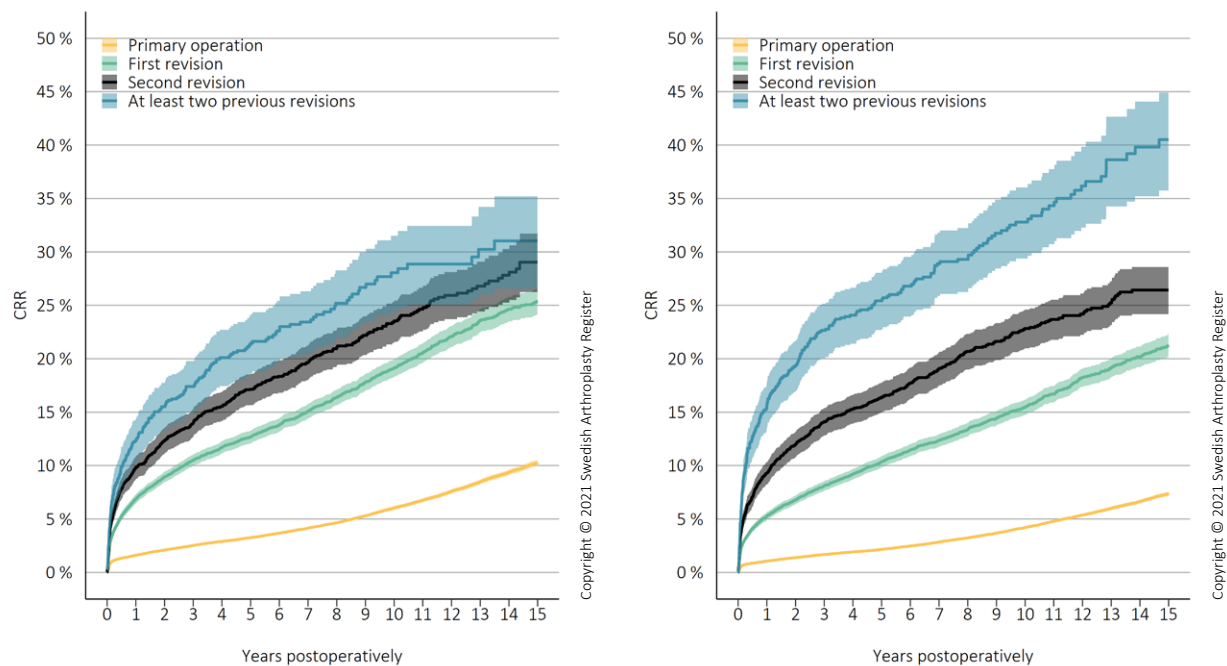


Figure 5.4.19. Cumulative risk of revision up to 15 years in males (a) and females (b) based on revision regardless reason or type of procedure in primary total hip replacements, first and second time revisions and in revisions of hip replacements with at least two previous revisions. Revisions from 2000 to 2020 are included.

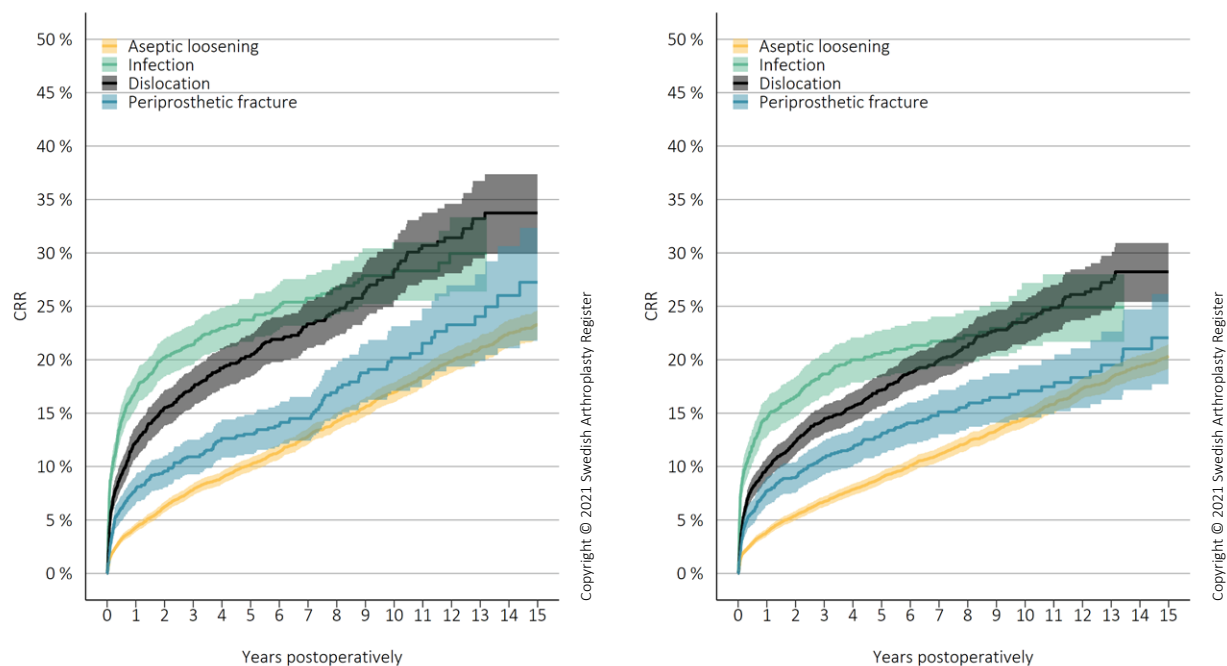


Figure 5.4.20. Cumulative risk of revision in males (a) and females (b) for the four most common reasons (loosening, infection, dislocation, periprosthetic fracture) regardless type of procedure and number of previous revisions. Revisions from 2000 to 2020 are included.

because the way of classifying implants to some extent affects how large the group “other” become. In 2020 the proportion of “other” cemented revision cups was 8.7%, while 31.9% of the uncemented cups ended up in the group “other” uncemented cups. On the stem side the difference was less pronounced, 8.5% for cemented stem and 13.3% for uncemented stem.

Results

The risk of revision increases gradually the more times a hip replacement has been revised. The cumulative risk for revision after 15 years for primary hip replacements operated on from 2000 onwards is $8.6 \pm 0.2\%$ (34,539 observations at 15 years), for first-time revisions $24.5 \pm 0.9\%$ (2,248 observations), for second-time revisions $27.5 \pm 1.8\%$ (446 observations) and for hips being revised earlier at least two times $36.7 \pm 3.5\%$ (126 observations) (figure 5.4.18). Figures 5.4.19a and b show cumulative revision risk for males and females respectively in the same period and with the same grouping. In the last years of observation however, data is more uncertain since it only remains 53 (hip replacements in males) and 73 observations respectively (females) at 15 years in the smallest group (two or more previous revisions). The grouping is otherwise the same as in figure 5.4.18 in other regards. The cumulative revision risk for males is higher in three of the groupings (primary, first-time, and second-time revision).

The prognosis measured as risk for re-revision will thus be worse for each revision performed. Evaluation after 15 years using Cox regression analysis and adjusting for age during index operation, sex, primary diagnosis, and operation year shows that the cumulative risk for (re)revision is 3.9 times higher (95% confidence interval: 3.7–4.0) after first-time revision compared with primary operation, 5.4 (5.1–5.8) times larger if the patient is revised for the second time and 7.9 times larger (7.2–8.6) if the hip has been revised at least twice times before. In general, males have about 30% increased risk for revision or re-revision (1.33; 1.30–1.37).

The reason why the patient is revised affects the risk of having additional revisions, as illustrated earlier in this section (table 5.4.3). Analysis of cumulative revision risk divided into reason for revision shows that the risk of re-revision is the greatest if the reason is infection or dislocation. The cumulative revision risk increases early after the index operation, which means that these revisions occur early (figures 5.4.20a and b). After four to five years the parallelism of the curves for the different reasons for

revision disappear mainly because the risk of re-revision due to infection decreases, and especially in the group previously revised most times. The mortality in this group is high and in addition there is a rising number of hips revised due to infection having been operated on with prosthesis extraction.

Summary

Revision of a hip prosthesis means that a patient previously operated on with hip prosthesis undergoes another operation where the entire prosthesis or parts of it are replaced or extracted.

Since 2000, the share of revisions when related to the total number of primary and revision surgeries has decreased from 12.2% to 8.4% in 2019. In the pandemic year 2020, the proportion increased to 9.1%. However, the absolute number of revisions increased, from 1,573 in 2000 to 1,802 in 2019 but was reduced to 1,522 in 2020.

Since 2000, loosening has been the major reason for first and multiple revisions, but its relative proportion has gradually decreased. Instead, the proportion of revisions due to infection has increased. In 2020, infection was the most common reason of revision in cases that has been revised at least once before.

Patients who are revised are in generally older, more often males, more often have a secondary osteoarthritis and higher degree of comorbidity than those who are operated with a primary prosthesis.

The number of low-volume units in Sweden has been relatively constant in the past ten years. In 2020, 38 operating units performed less than 25 revisions. If only revisions of total hip prosthesis are counted, the numbers are affected marginally (36 less than 25, 22 less than 10 revisions).

The risk of suffering further revisions increases with increasing number of previous revisions. The prognosis is worst in revisions due to infection followed by revisions due to dislocation. The importance of optimizing the outcome of primary replacements can therefore not be overemphasized.

5.5 Evaluation of implants and implant combinations

Author: Johan Kärrholm

In the last 25–30 years the results after hip replacement surgery measured as the risk for revision gradually changed. The risk of early revision has increased (figure 5.5.1), but in a longer perspective the results have improved (figure 5.5.2). The increase in early revisions can partly be explained by an increasing number of revisions due to infection (figures 5.5.3–5), which is explained more in detail in chapters 5.2 to 5.4. Increased use of uncemented stems with increased risk of early periprosthetic fracture may also have played role. The reasons behind the lower risk of revision after approximately two to four years when the curves in figures 5.5.1 and 5.5.2 start to converge, to later cross each other and thereafter diverge are unclear. In chapter 5.3 we could however observe that the number of revisions due to loosening gradually reduced in the last two decades. Conversion from older polyethylene types to more wear-resistant polyethylene with extra crosslinking has certainly contributed to that the problems with wear,

osteolysis and loosening have been reduced. Increased use of uncemented fixation with a less risk of loosening in the longer perspective may also have played a part.

The Swedish Knee Arthroplasty Register has for several years presented, one so-called ranking list to be able to assess if the risk of revision after surgery on a specific unit is on expected level or not. This year, the Swedish Arthroplasty Register presents corresponding analysis for primary hip replacements performed due to primary osteoarthritis with five (figure 5.5.5) respectively ten-years follow-up (5.5.6). The cumulative risk of revision has been adjusted for differences in age and sex distribution. Differences beyond what is expected may be due to several factors that can be influenced, such as the extent and quality of pre-operative planning and patient optimization, surgical process, and technique as well as choice of implant. Other factors such as patients' comorbidity can only partially be affected by preoperative optimization. The view is also disturbed by patients with high comorbidity and deviant hip anatomy are centralized to certain hospitals. The threshold for performing revision may also vary between different units. Nonetheless, the analysis performed can stimulate a causal analysis and if needed, initiate improvement work.

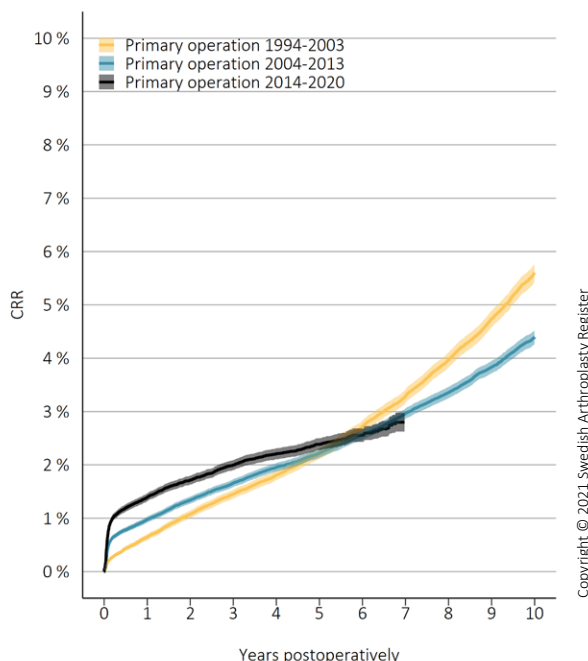


Figure 5.5.1. Cumulative risk of revision due to any reason up to 10 years after the primary hip replacement. Total hip replacements due to osteoarthritis operated 1994 until 2020 and separated into three following periods are shown.

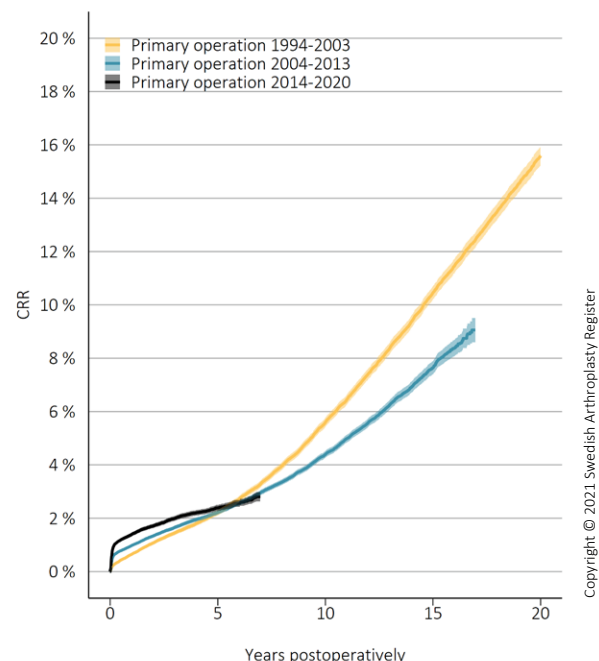


Figure 5.5.2. Cumulative risk of revision due to any reason up to 20 years after the primary hip replacement. Total hip replacements due to osteoarthritis operated 1994 until 2020 and separated into three following periods are shown.

The two merged registers in the Swedish Arthroplasty Register have a long history, the longest in the world. Continuous feedback of results has meant that, basically, only well-documented implants are used routinely. Nonetheless there are differences in cumulative risk of revision between the implant combinations used. To illustrate this cumulative risk of revision is shown for those 15 most used implant combinations since 2001 (figure 5.5.7). Since the risk of revision is low for most of them it is important to point out that many factors not being directly implant related may have affected the result and especially for those implant combinations that have the lowest number of observations.

New regulations for introduction of implants

The European union's new regulatory framework for orthopaedics implants (Medical Device Regulation, MDR) became effective in the end of May 2021. The regulation is comprehensive and emphasises the importance of clinical detectable benefit related to the degree of risks, unique identification of implants and post market surveillance. The regulation not only includes completely

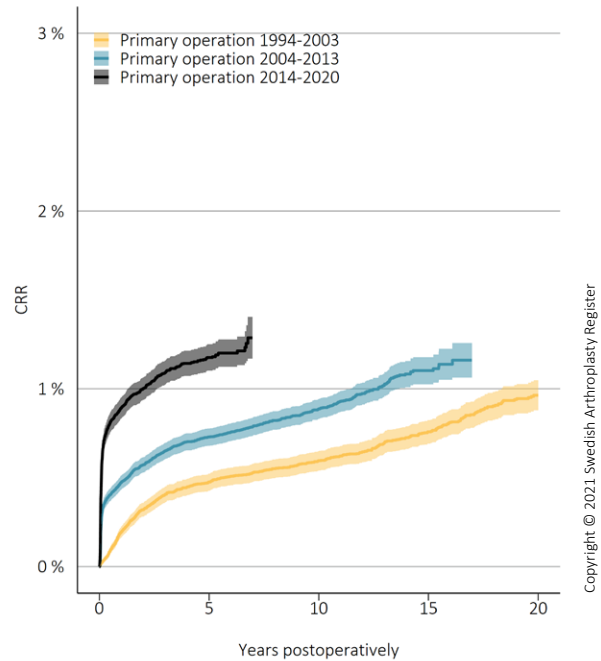


Figure 5.5.3. Cumulative risk of revision due to infection up to 20 years after the primary hip replacement. Total hip replacements due to osteoarthritis operated 1994 until 2020 and separated into three following periods are shown.

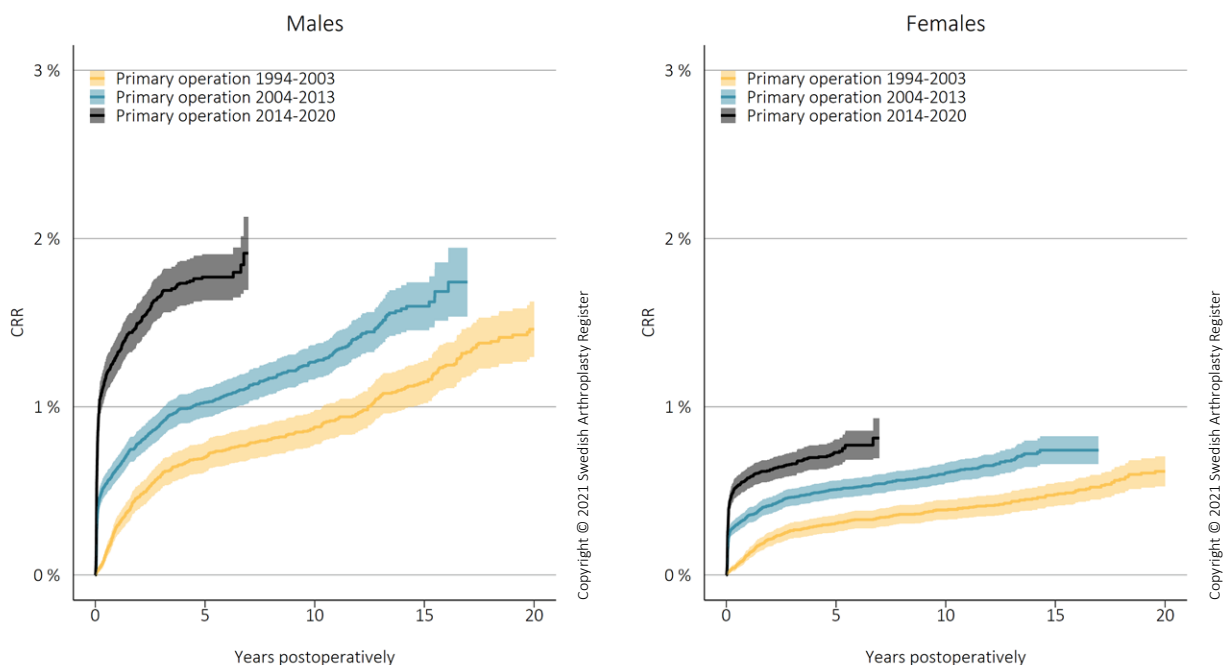


Figure 5.5.4. Cumulative risk of revision due to infection up to 20 years after the primary hip replacement in males (a) and in females (b). Total hip replacements due to osteoarthritis operated 1994 until 2020 and separated into three following periods are shown.

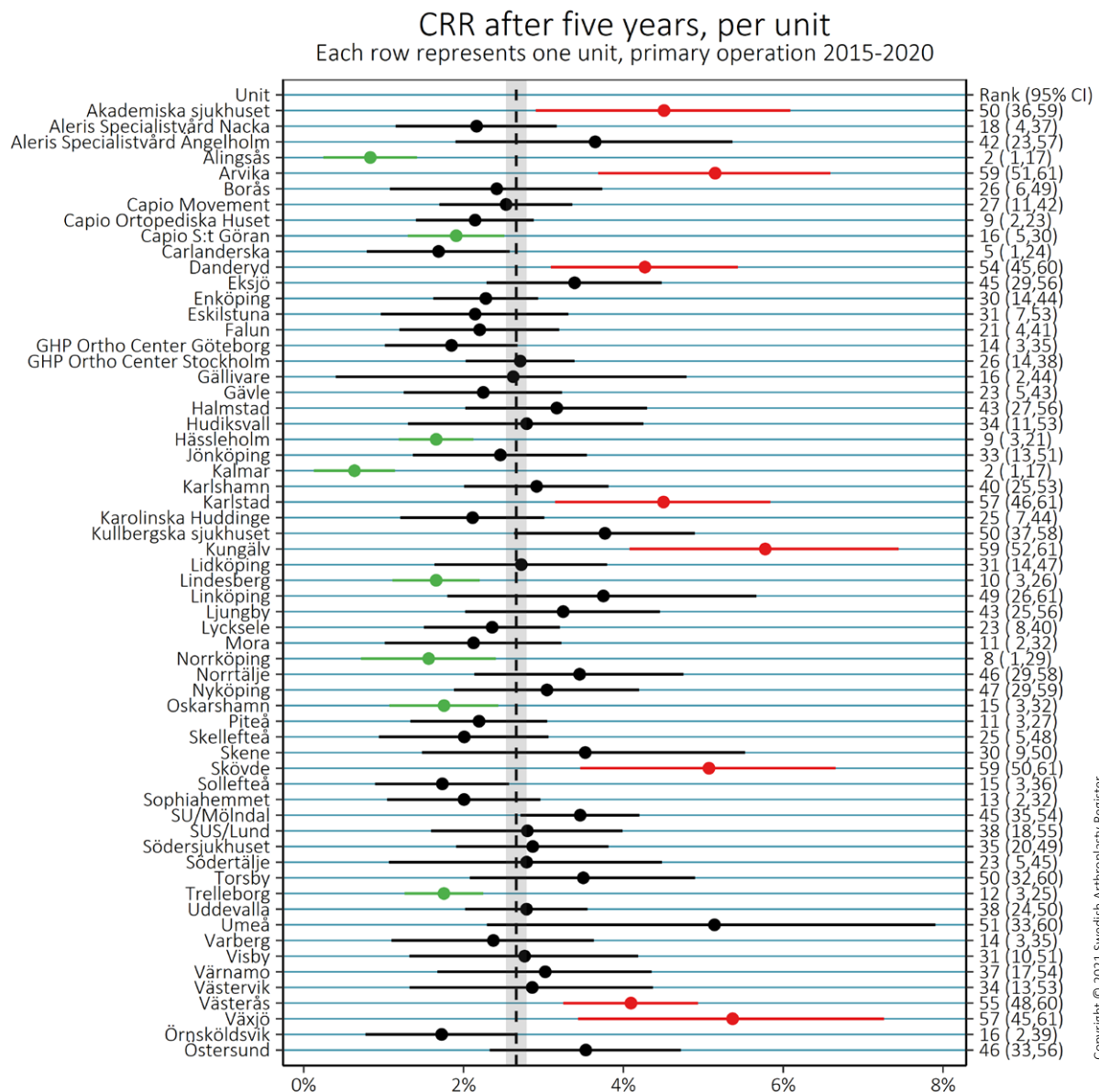


Figure 5.5.5. Comparison of cumulative risk of revision for any reason up to 5 years for primary hip replacements performed 2015–2020. Risk is presented as percent with 95% confidence interval. Green and red respectively indicate if the unit is better or worse than the national average.

new implants but can also include a new size of an existing prosthesis. Important in the new regulation is that the manufacturer shows that the new prosthesis entails a clear clinical patient utility combined with a low risk of complications. In practice, this means that clinical use without restrictions cannot be allowed before the follow-up of a sufficiently large group of patients during enough time. Furthermore, the clinical outcome must be based on patient reported outcomes, live up to contemporary standards and the risk of complications should be low. How the detailed regulation will be implemented will

probably not be clear until 2024 then the transition period to the new regulation must be completed. The concept also includes the construction of a data base (European Database on Medical Devices, EUDAMED) where all information on a current prosthesis is to be collected and to which complications can be reported. This new regulation is welcome as the patient utility is great by the level of safety and that the risk of future implant related problems is reduced. The regulation also entails that it will become more complicated, time-consuming, and probably also more expensive to introduce new implants and

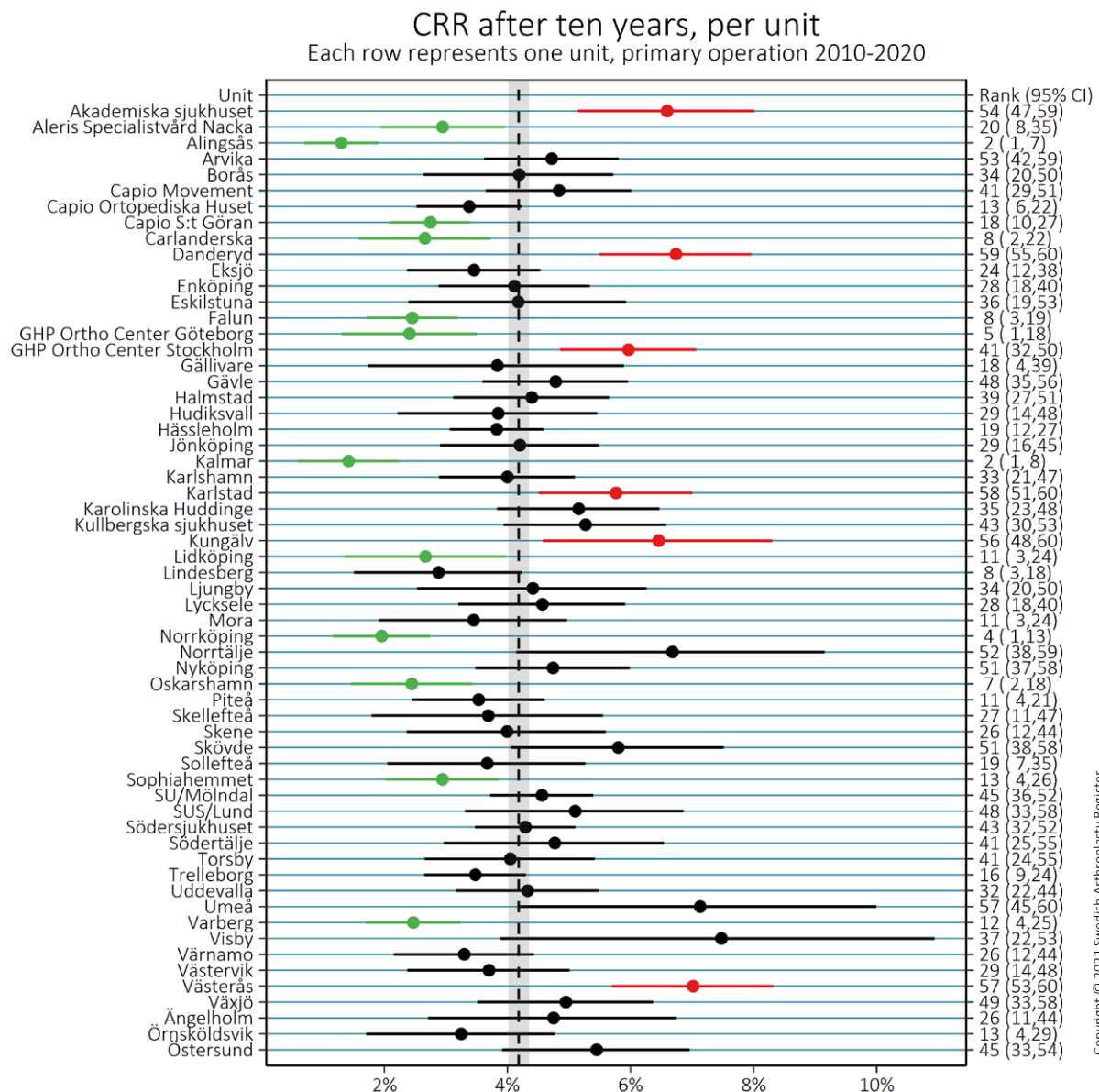


Figure 5.5.6. Comparison of cumulative risk of revision for any reason up to 10 years for primary hip replacements performed 2010–2020. Risk is presented as percent with 95% confidence interval. Green and red respectively indicate if the unit is better or worse than the national average.

innovations. On the other hand, the need for well-designed clinical studies also will increase. Reasonably the prices will also be affected but to what extent is so far not clear. For details see also: ec.europa.eu/health/sites/default/files/md_newregulations/docs/timeline_mdr_en.pdf and eur-lex.europa.eu/eli/reg/2017/745/2017-05-05.

The situation in Sweden

In Sweden we have had a restrictive attitude for a long time to change standard implants. This attitude has proved

successful since the clinical results for the majority of the new implants introduced on the market at best is on par with already existing and several of them are worse. In some cases, this cautious attitude may entail that implants with better qualities than current standard is introduced late in Swedish healthcare. This drawback weighs relatively easy in light of the good results noted for the most commonly used types of prosthesis in Sweden and the sometimes catastrophic consequences that may be the result when a new and unknown implant is operated on a large number of patients.

Today there are no preclinical tests that in a safe way can tell if a new prosthesis works better or worse than existing. Since the prostheses used in Sweden today are of a very high standard it is mainly in selected patient groups expected further implant development can make a difference. Change of standard implant also entails some risk taking since new routines must be learnt. Against this background it seems obvious that change of implant only should be carried out in those cases where there is a clinical need and where the replacing implant has documented advantages. Service and price also plays a role, although usually the price is a small part of the total cost.

This year's implant evaluation

In previous annual reports we have briefly presented summaries on how some other joint replacement registers evaluate implants to illustrate that the procedure for implant evaluation is neither simple nor obvious. Most registers use the outcome revision regardless of cause and regardless of which component that is revised. Some registers multiply the number of observed components with the number of years of observation, which means that one not considers that the reason of revision varies over time. To the extent that comparison with other prostheses is performed, the comparative group can encompass all other implants, all other implants of the same product category, a selected reference group or a reference implant. Sometimes a fixed limit is used for example 5% cumulative risk of revision risk after 10 years. To date, there has been no established standard. Such a standard is no entirely easy to achieve since the prerequisites varies greatly between different registers with regarding total number of observations, the number of different implants that are used within the register's covering area, the length of the follow-up time and the extent of the data capture of the individual register. Furthermore, exact limit values for quality is a constructed limit based on what is considered acceptable at a certain time. What is acceptable standard of today does not necessarily have to be the same 10 to 20 years later.

Control group – choice of outcome

In the last five annual reports we have used a reference group encompassing implants with at least 95% implant survival after ten years and where at least 50 implants have been followed up to this time point. The outcome has in assessment of cups been aseptic cup revision including liner revision for uncemented modular cups. For stems

the corresponding outcome is aseptic stem revision. In both cases revisions including more than one component have been counted.

In the first annual report of the Swedish Arthroplasty Register we have chosen, to as much as possible, harmonize the evaluation of hip and knee prostheses. This means that instead of a reference group, used cups and stems are compared to a reference implant. The selection criteria for the reference implants are based on high and continuous use during analysed period without the use of completely strict scientific criteria. The advantage with a reference implant is that data can become easier to interpret. One possible drawback is that it can need to be changed if it is modified, or its relative use decreases or ceases. Like at evaluation of knee prostheses the analysis is based on components inserted 2010–2019 with follow-up to the 31st of December 2020. Further, only patients who have surgery due to primary osteoarthritis are included. When analysing cups, hip prostheses both with cemented and uncemented stems are included. On the same way the analyses of stems include hips with both cemented and uncemented cups. This procedure is not obvious since for example the risk of cup revision may be affected by the choice of stem fixation. Uncemented stems are more likely to suffer from early periprosthetic fracture when in a revision maybe also the cup is changed to avoid dislocation. However, we believe that this bias is relatively small and our choice is based on a desire to maintain high external validity.

In the group of cemented cups, Marathon has been used as reference. This cup was introduced in 2008 and has been used in Sweden in more than 1,000 primary operations since 2009. The polyethylene is radiation-treated with 5 MRad. In table 5.5.1 we find that none of the other cups used between 2010 and 2019 has significantly lower risk of aseptic caused cup revision in Sweden. Two cups with high-molecular polyethylene ZCA XLPE and Reflection XLPE have an increased risk for revision. In the first case the most common reason for revision is dislocation (52.8%) followed by loosening (34%). The dislocation problems associated with the ZCA-cup have been pointed out in previous annual reports and may probably be explained by the fact that the cup is relatively shallow. Regarding Reflection XLPE the number of observations is limited (10 cup revisions whereof nine due to loosening) why not possible to safely say if the problem is real and if it may be related to the cup's construction. Several cups made of older types of polyethylene show an increased

Hazard ratio for cemented cup revision. The Marathon cup is reference.

	n	Follow-up *	HR	95% CI		p-value
				Lower	Upper	
Lubinus x-link	29,454	9	1.09	0.82	1.43	0.55
Lubinus	22,133	10	1.93	1.51	2.46	<0.01
Exeter Rim-fit	16,651	10	0.9	0.65	1.25	0.53
Marathon	14,084	10	reference			
ZCA XLPE	9,204	10	1.92	1.46	2.53	<0.01
Contemporary Hoded Duration	3,6	10	3.53	2.63	4.72	<0.01
IP Link	1,331	7	0.87	0.32	2.39	0.79
ZCA	974	6	2.07	1.13	3.81	0.02
FAL	903	10	2.75	1.69	4.5	<0.01
Avantage	762	8	1.45	0.53	3.96	0.47
Exceed ABT E-poly without flange (cem)	753	9	0.92	0.34	2.51	0.87
Contemporary	496	10	1.76	0.81	3.83	0.15
Elite Ogee	366	10	1.04	0.33	3.3	0.95
Reflection XLPE	318	10	3.91	2.02	7.56	<0.01
Exeter	212	10	4.07	1.88	8.85	<0.01
FAL x-link	203	9				
Low profile cup	139	6	2.27	0.56	9.22	0.25
Polarcup cemented	124	6	2.27	0.32	16.35	0.41
Elite plus	109	10	2.1	0.51	8.55	0.3
Other	231	10	5.25	2.43	11.34	<0.01
Surgical year			1.04	1.01	1.08	0.01
Age			0.97	0.96	0.98	<0.01
Sex			1.04	0.91	1.19	0.55

Table 5.5.1. Risk (Hazard ratio with 95 % confidence interval (CI)) in cemented cup revisions. The Marathon cup is the reference. To be included in the analysis at least 100 observations are needed. Implants without any reported cup revision is presented in italics. The hazard ratios are adjusted for age, sex and surgical year.

* The follow-up is presented until 20 observations are left at risk.

Hazard ratio for uncemented cup revision. The Trilogy cup is used as reference.

	n	Follow-up*	HR	95% CI		p-value
				Lower	Upper	
Pinnacle W/Gription 100	7,001	8	2.97	1.8	4.9	<0.01
Trident hemi	4,756	10	0.82	0.44	1.54	0.54
Trilogy	4,428	10	reference			
Continuum	4417	10	3.49	2.22	5.5	<0.01
Pinnacle 100	3058	10	2.63	1.59	4.36	<0.01
Exceed ABT Ringlock	1860	9	1.71	0.9	3.24	0.1
Trilogy IT	1492	8	5.92	3.52	9.95	<0.01
Pinnacle sector	1067	10	1.66	0.72	3.84	0.24
Pinnacle W/Gription Sector	1056	6	1.71	0.64	4.55	0.29
Trident AD LW	827	10	1.82	0.75	4.42	0.19
Allofit	751	10	0.75	0.23	2.49	0.64
Trident AD WHA	740	10	1.74	0.76	4	0.19
Regenerex	724	10	1.02	0.36	2.93	0.97
Tritanium	696	10	1.67	0.69	4.06	0.25
G7 PPS	654	4	2.21	0.65	7.52	0.2
Delta-TT	543	7	3.46	1.49	8.04	<0.01
BHR	440	10	4.85	2.54	9.28	<0.01
TMT revision	270	10	5.83	2.74	12.4	<0.01
TMT modular	238	10	0.53	0.07	3.87	0.53
Ranawat/Burstein	154	10	1.43	0.34	6.04	0.62
Delta Motion	129	9	1.27	0.17	9.37	0.81
Allofit Alloclassic	128	9	4.47	1.56	12.8	<0.01
Other	1041	10	4.12	2.41	7.04	<0.01
Surgical year			0.92	0.88	0.97	<0.01
Age			1.01	1	1.02	0.13
Sex			1.18	0.95	1.45	0.13

Table 5.5.2. Risk (Hazard ratio with 95% confidence interval (CI)) in uncemented cup revisions. The Trilogy cup is the reference. To be included in the analysis at least 100 observations are needed. Implants without any reported cup revision is presented in italics. The hazard ratios are adjusted for age, sex and surgical year.

* The follow-up is presented until 20 observations are left at risk.

Hazard ratio for cemented stem revision. The SPII stem is reference.

	n	Follow-up*	HR	95% CI		p-value
				Lower	Upper	
SPII standard 150	49,347	10	reference			
Exeter standard	26,604	10	1.81	1.47	2.22	<0.01
MS-30 polished	10,959	10	2.06	1.6	2.66	<0.01
SPII standard 130	1,883	6	2.83	1.52	5.26	<0.01
CPT	374	9	8.69	4.43	17.04	<0.01
Spectron EF Primary	347	10	4.91	2.49	9.66	<0.01
BHR	219	10	3.86	1.95	7.64	<0.01
BHR upgrade	178	10	2.45	0.98	6.14	0.06
Exeter short rev stem	115	7	16.59	6.13	44.9	<0.01
Other	366	10	3.13	1.45	6.75	<0.01
Surgical year			1.03	0.99	1.08	0.1
Age			0.99	0.98	1	0.05
Sex			0.44	0.36	0.52	<0.01

Table 5.5.3. Risk (Hazard ratio with 95% confidence interval (CI)) in cemented stem revisions. The SPII stem is the reference. To be included in the analysis at least 100 observations are needed. Implants without any reported cup revision is presented in italics. The hazard ratios are adjusted for age, sex and surgical year.

* The follow-up is presented until 20 observations are left at risk.

risk for cup revision (Lubinus, Contemporary Hooded Duration, ZCA, FAL, Exeter). In four of the cases, loosening is the most common reason for revision while one of them (FAL) most often has been revised due to dislocation. Even if the good results for cups made of polyethylene with extra crosslinking speaks in their favour, the mean follow up time for cups with older polyethylene is in general longer, which may have affected the results. The majority of the cups made of polyethylene with extra crosslinking show no definitive differences despite the quality of the polyethylene is not identical. Possibly, this picture will change with longer follow-up.

The Trilogy cup in standard form is the reference for uncemented cups. It has been used since the mid-1990s in Sweden and almost exclusively with the new type of polyethylene since 2007. In table 5.5.2 none of the other cups differ significantly with lower risk of cup and/or liner revision. Eight cup designs differ for the worse with increased risk. Regarding three of them (Continuum, Trilogy IT, TMT revision) their increased risk for revision

has been dealt with in earlier reports from the Register. In all three cases the most common reason for revision was dislocation, which to some extent could be explained by the design of the cup and as well as that they rarely are used together with a liner that has some form of in-built protection against dislocation. Two of the remaining in this year's analysis (Pinnacle W/Gription 100 and Pinnacle 100) have been inserted in large numbers during the current period. Pinnacle W/Gription 100 has between 2010 and 2019 been the most used uncemented cup (7,001 reported primary hip replacements). In 50% of cases the reason for revision was dislocation followed by loosening (19.7%). In 83% of cases a standard liner has been used without any modification to protect against dislocation. Regarding Pinnacle 100 the picture is more difficult to interpret. Revision due to dislocation has been performed in 34.6% and due to loosening in 31.4% of the cases. Hereafter follow a large number of different causes where several of them probably cannot be directly related to the cup (fracture of femur, stem fracture, incorrect insertion). 19 cup revisions are reported for the

Hazard ratio for uncemented stem revision. The Corail stem is reference.

	n	Follow-up*	HR	95% CI		p-value
				Lower	Upper	
Corail	26,157	10	reference			
CLS	6,595	10	0.85	0.63	1.14	0.27
Bi-Metric X por HA NC	5,47	10	1.17	0.9	1.53	0.24
Accolade II	2,374	8	0.54	0.28	1.01	0.05
ABG II HA	1,74	10	2.56	1.89	3.47	<0.01
M/L Taper	1,489	8	0.51	0.23	1.14	0.1
Wagner Cone	854	10	2.6	1.65	4.12	<0.01
Accolade straight	743	10	1.13	0.63	2.03	0.68
Echo Bi-Metric (FPP)	617	5	1.43	0.58	3.49	0.44
Fitmore	256	9	2.31	1.08	4.91	0.03
CFP	233	10	3.14	1.6	6.15	<0.01
Bi-Metric por HA	222	5	0.58	0.08	4.14	0.59
SP-CL	208	4				
Echo Bi-Metric (RPP)	161	6	1.07	0.15	7.68	0.94
Symax	160	10				
Bi-metric HA FMRL	157	3	0.93	0.13	6.65	0.94
Synergy	108	10	0.6	0.08	4.28	0.61
Other	534	10	2.05	1.17	3.61	0.01
Surgical year			0.97	0.93	1	0.06
Age			1.02	1.01	1.03	<0.01
Sex			0.74	0.62	0.88	<0.01

Table 5.5.4. Risk (Hazard ratio with 95 % confidence interval (CI)) in uncemented stem revisions. The Corail stem is the reference. To be included in the analysis at least 100 observations are needed. Implants without any reported cup revision is presented in italics. The hazard ratios are adjusted for age, sex and surgical year.

* The follow-up is presented until 20 observations are left at risk.

BHR-cup, of which six each due to loosening, femoral neck fracture or more distal femoral fracture, respectively. There are eight revisions for the Delta-TT cup reported, three each due to loosening and pain respectively and two due to dislocation. Regarding Allofit Alloclastic there are four revisions whereof three are due to dislocation based on a limited number of observations (n=128).

The SP-stem has been used in Sweden since the early 1980s. During the second half of this decade modification with a modular femoral head was introduced and the stem changed its name from SPI to SPII. SPII is the most used prosthesis stem in the country and has been chosen as the reference stem. In table 5.5.3 we see that all stems, except for BHR Upgrade (resurfacing prosthesis) show significantly increased risk of revision compared to SPII. This observation should be interpreted in the light of the fact that three of the groups (including the reference group) includes 10,000 operations or more and that the number of revised stems in these groups is low (0.5% or lower). Three of the stems with relatively few observations (Spectron EF Primary, BHR, BHR Upgrade) are no longer used due to poor results and/or serious complications.

Regarding Exeter standard, the poorer outcome is likely fully explained by the increased risk for periprosthetic fracture. The proportion that is revised due to loosening and dislocation is numerically slightly lower than for SPII. MS30 is revised more often than SPII due to dislocation and periprosthetic fracture but as for Exeter the proportion of revisions due to loosening is lower. CPT also has a larger proportion of revision due to periprosthetic fracture. This is also applying to the Exeter short revision stem which also has a larger proportion of revisions due to implant fracture and loosening. Finally, it should be noted that the differences addressed here are only observations and demand deeper analysis.

The Corail stem is currently the most common uncemented stem in Sweden. A few insertions are reported until 2005 where after the number of reported stems increased and passed 1,000 (n=1,364) in 2010. The Corail stem is available in three main variants, two of which mainly or only used with (coxa vara) or without collar (high offset). As a reference prosthesis we have here chosen to combine all these variations in one group against the background that the other uncemented stems are treated in the same way.

Among the uncemented stems there are four designs that differs for the worse compared to the reference group. For three of these (ABG, CFP, Fitmore) there are only one or two reported prostheses during 2019 and no registered insertion in 2020. The fourth, Wagner Cone, was reported in 65 cases in 2019 and in 40 cases in 2020. In all four cases there is an overrepresentation of the proportion of revisions due to loosening compared to the Corail stem. For all except Fitmore there is also a slightly larger proportion of revisions due to dislocation. ABG has an overrepresentation of revisions due to periprosthetic fracture and Fitmore due to technical problems (incorrectly inserted implant). Especially the Wagner Cone stem is often used in anatomical deviations, for example if you need to adjust for deviations of the version of the femoral neck. The deviant result for this stem could therefore, at least partially be explained by that more complicated cases operated with this implant.

Summary

In the last 25–30 years, the risk of revision within two years has increased. The long-term outcome measured as the risk of revision after 10 to 20 years has improved, probably due to decreasing problems with wear, osteolysis and loosening.

The European Union's new regulatory framework for orthopedic implants entered into force at the end of May 2021. The new regulatory framework means that clinical patient benefit combined with low risk of complications must be proven before an implant can be marketed. This means that clinical use without restrictions cannot be allowed until sufficiently large patient population has been followed-up for a sufficiently long time. Until 2024 transitional rules apply.

This year, the Swedish Arthroplasty Register introduces a new way of evaluating cups and stems using reference implants similar to what was previously practiced by the previous knee arthroplasty register. None of the prosthesis components evaluated in this way show statistically significant lower risk of revision compared to the reference implant.

5.6 Hip fracture treatment with total or hemiarthroplasty

Author: Cecilia Rogmark

In a time when the branches of the quality registers family tree entwine to new formations also the hip fracture twig seeks its relatives. This year's chapter on hip arthroplasty as fracture treatment will be short. In part the Swedish Arthroplasty Register (SAR) must find its form for the new annual report, in part many analyses are made in parallel with the Swedish Fracture Register (SFR), whose annual report for 2020 contains data chapter on hip fracture treatment. We are aware of the cumbersome procedure in having to register individuals with hip fracture in several registers. To lessen that work load, we have introduced direct linkage of certain variables between SAR and the SFR (see below). There is also hope of future co-operation between the SFR and the Swedish National Hip Fracture Registry. That diagnosis is the way into the SFR and into the Swedish National Hip Fracture Registry, while the implant choice is the way into the SAR means that each register has its own unique data, and the actual

overlap is relatively small. The SAR can only describe the outcome for those that undergo a hip arthroplasty, those that are treated with a different method than hip arthroplasty is not part of our analyses. The younger with a femoral neck fracture, for example, are more often treated with internal fixation. They only end up in the SAR in those cases when the fracture does not heal, and they have undergone an arthroplasty as a salvaging procedure. For an individual with a very short, expected survival the lesser procedure of internal fixation is sometimes used as part of palliation, instead of a hip arthroplasty. In some cases, operation is abstained from completely. If the units have varying guidelines for how internal fixation, hip arthroplasty and non-operative treatment should be used, their results will also be affected by these strategies. Better cooperation between the databases that contain hip fracture data, and a facilitation of reporting is the future way for more complete and just analyses!

When it comes to the use of hip arthroplasty as fracture treatment the results over the last five years are remarkably constant: age distribution, the proportion of patients with or without comorbidities (ASA class), the proportion of under- and overweighted, and the choice of surgical

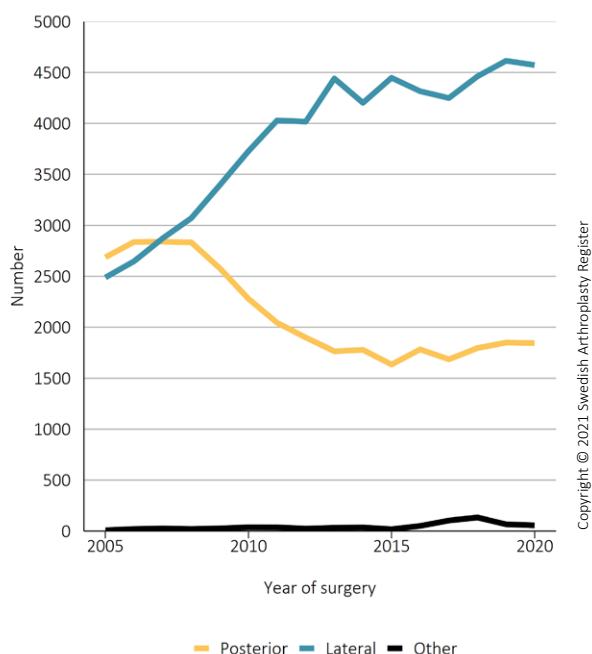


Figure 5.6.1. Choice of surgical approach for arthroplasty due to fracture.

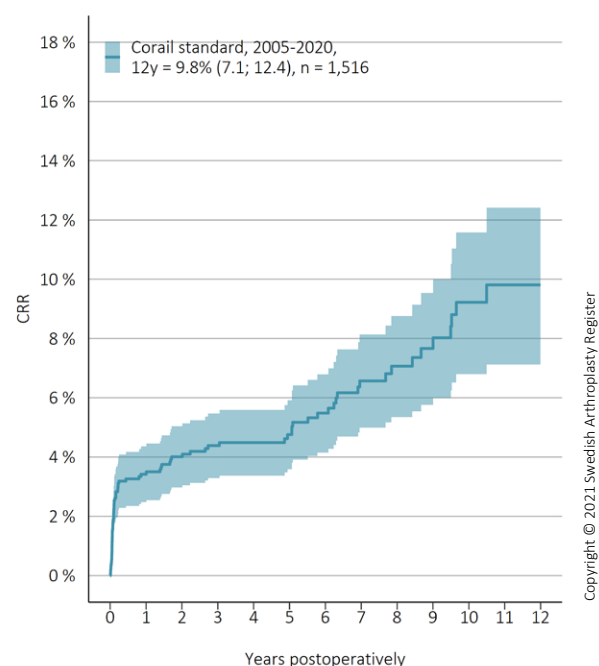


Figure 5.6.2a. Cumulative risk of revision for the cementless Corail stem.

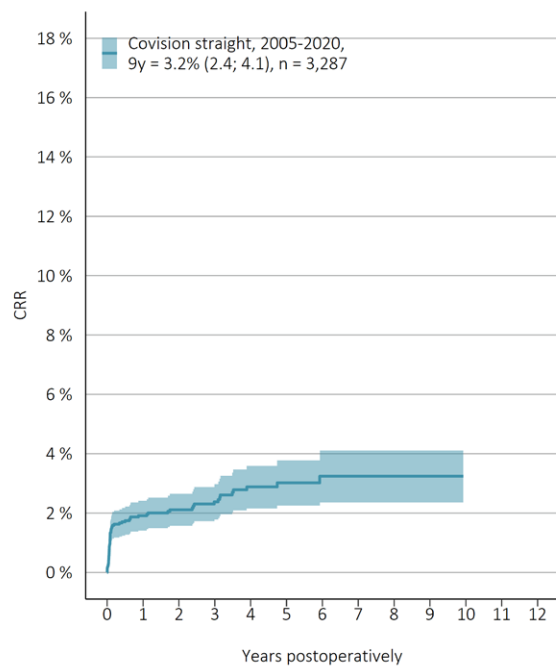


Figure 5.6.2b.

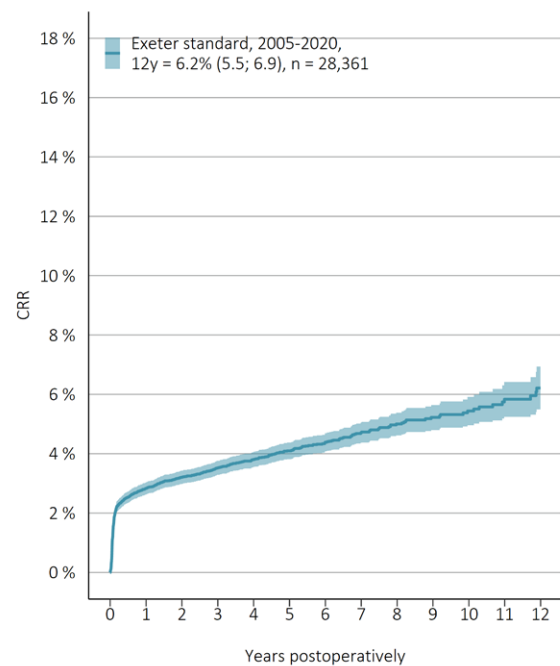
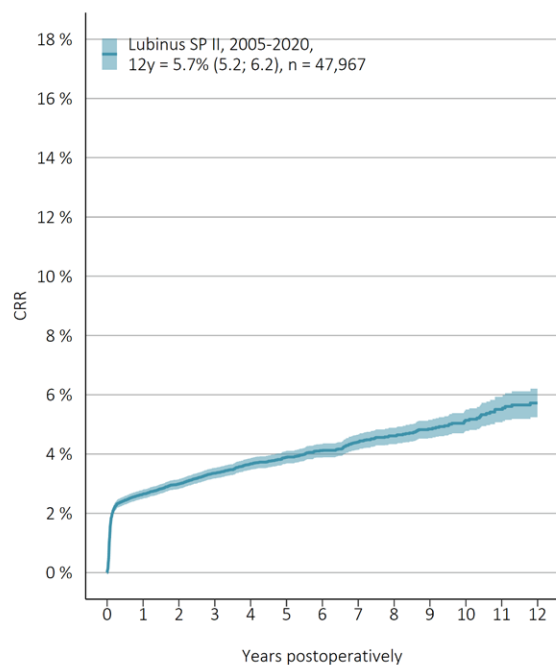
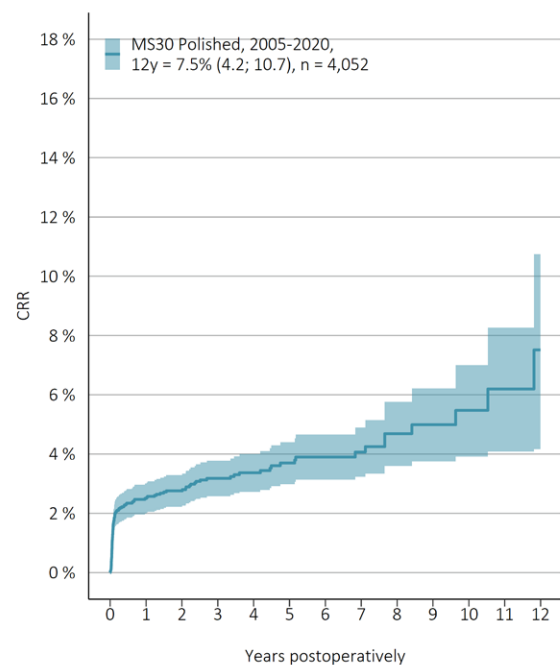


Figure 5.6.2c.



Figur 5.6.2d.



Figur 5.6.2e.

Figures 5.6.2b-e. Cumulative risk of revision for the four most common cemented stems.

approach are unchanged (table 5.6.1, figure 5.6.1). Only a weak increase of the proportion of men can be seen. Worth to note is that the obese outnumber those that are underweighted – hip fracture is often otherwise associated with frailty and malnutrition. Among the implants four cemented stems dominate like before (table 5.6.2) with a relatively equal prevalence of revision surgery at 3–5% after 10 years (figure 5.6.2 b-e). That the extremely large proportion of cemented stems is a good choice is evidenced by the revision frequency of the uncemented Corail stem at 9% (figure 5.6.2 a). That the direct-lateral approach is the most common approach may also be an advantage, in any case measured as a lower proportion of revisions during the whole 12-year period compared with the posterior approach (figure 5.6.3).

So, is this stationary picture and “wise” use of surgical techniques a receipt that proves that everything is perfect and that the guidelines of the Swedish orthopaedic clinics are crystal clear? Probably not. A first question is if we just should accept 5% revisions after 10 years for those who have undergone hip arthroplasty due to fracture? The number is considerably lower for osteoarthritis patients. Furthermore, the “revision rate” is only the tip of the iceberg; many are affected by complications that do not lead to such a large procedure, but the patients’ suffering can however be large. The orthopaedic profession is aware of this, and act in different ways to improve the result. During the 2010s many saw a potential quality improvement in increasing the number of total arthroplasties at the expense of hemiarthroplasties. The Swedish units vary

Demography in hip arthroplasty as fracture treatment

	2016	2017	2018	2019	2020
Number	6,172	6,043	6,394	6,533	6,476
Mean age (SD)	81.33 (9.50)	81.33 (9.54)	81.47 (9.58)	81.59 (9.24)	81.42 (9.44)
Age group (%)					
<45	19 (0.3)	16 (0.3)	15 (0.2)	11 (0.2)	17 (0.3)
45–54	52 (0.8)	52 (0.9)	51 (0.8)	51 (0.8)	43 (0.7)
55–64	220 (3.6)	255 (4.2)	228 (3.6)	238 (3.6)	248 (3.8)
65–74	1,066 (17.3)	1,013 (16.8)	1,134 (17.7)	1,047 (16.0)	1,067 (16.5)
75–84	2,225 (36.0)	2,141 (35.4)	2,248 (35.2)	2,443 (37.4)	2,422 (37.4)
≥ 85	2,590 (42.0)	2,566 (42.5)	2,718 (42.5)	2,743 (42.0)	2,679 (41.4)
Females (%)	4,056 (65.7)	3,993 (66.1)	4,139 (64.7)	4,216 (64.5)	4,047 (62.5)
BMI (%)					
<18,5	306 (6.8)	296 (6.7)	317 (6.8)	365 (7.0)	342 (6.7)
18,5–25	2,531 (56.4)	2,506 (56.6)	2,654 (56.6)	2,887 (55.6)	2,914 (57.2)
25–30	1,275 (28.4)	1,247 (28.2)	1,337 (28.5)	1,516 (29.2)	1,432 (28.1)
30–35	310 (6.9)	309 (7.0)	313 (6.7)	362 (7.0)	332 (6.5)
35–40	54 (1.2)	58 (1.3)	61 (1.3)	52 (1.0)	64 (1.3)
≥ 40	14 (0.3)	13 (0.3)	9 (0.2)	14 (0.3)	9 (0.2)
ASA class (%)					
ASA I	239 (4.1)	228 (4.0)	251 (4.1)	236 (3.7)	161 (2.6)
ASA II	2,130 (36.3)	2,081 (36.1)	2,189 (36.0)	2,259 (35.7)	2,141 (34.2)
ASA III	3,101 (52.9)	3,127 (54.3)	3,273 (53.8)	3,425 (54.2)	3,535 (56.4)
ASA IV	395 (6.7)	326 (5.7)	373 (6.1)	400 (6.3)	426 (6.8)

Table 5.6.1. Demography in hip arthroplasty as fracture treatment 2016–2020.

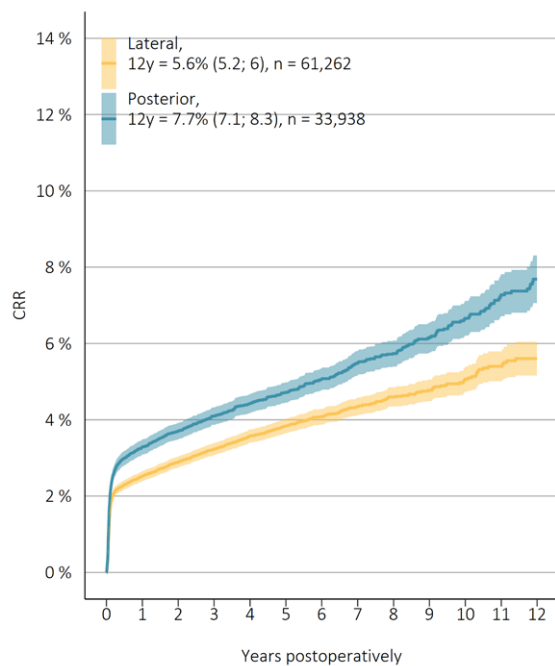


Figure 5.6.3. Cumulative risk of revision related to surgical approach.

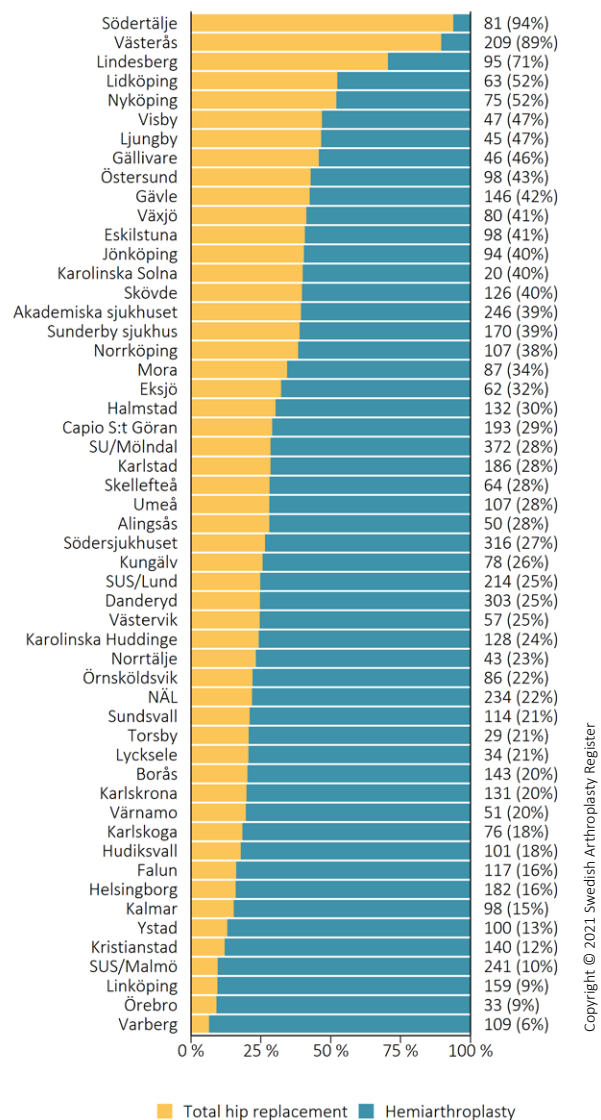


Figure 5.6.4. Proportion of total and hemiarthroplasty as treatment of hip fracture. To the right, the number and percentage of total hip arthroplasty.

extremely in their use of total arthroplasty (figure 5.6.4), with everything from 6 to 94% total arthroplasties. The variations may be explained by the access to arthroplasty specialists in emergency duty (total arthroplasty is more demanding than hemiarthroplasty), but also by different interpretations of available evidence. A certain anti-climax in this debate is seen in figure 5.6.5 where no difference is seen regarding revision surgery between the implants. This correlates well with a current meta-analysis of 16 randomised clinical studies where no difference of clinical

relevance was found between total and hemiarthroplasty for any important outcome (Ekhtiari et al. JBJS, 102(18), 1638-1645 (2020)). It is probably not the implant choice that determines the patient's future if we stick to well-documented prostheses and surgical techniques. Additional attempts at improving the result through implant choice is the increase of dual-mobility cups during the 2010s (table 5.6.3, figure 5.6.6). This option is expected to decrease the risk for dislocation when a posterior approach is used, but any difference in the prevalence of revision

cannot be seen in figure 5.6.5. Here it is however in order to emphasise that the dislocation prevalence is gravely underestimated when using revision as outcome. A register-based randomised study (Duality) is running with the aim of analysing the total dislocation frequency after different combinations of cups and surgical approaches.

Undisplaced femoral neck fracture, where internal fixation has been completely prevailing, is now studied in the Hipsther-study, to determine if hip arthroplasty may be a better option. It is a register-based randomised study based on the SFR and aims at including 1 400 individuals. This means that the number of fracture-related hip arthroplasties increases during the study time, and depending on the result of the study, maybe also in the future.

There is linking of data between the SAR and the Swedish Fracture Register, which in its first part is automatic. If an operation with hip arthroplasty due to hip fracture is found in one of the registers but not in the other, data is

transferred to the other register. In the next step, however, register personnel must manually complete the registration. A common problem, is that the SAR does not contain the exact date of injury. In the linkage it is assumed that the hip fracture occurred the day before the arthroplasty. There is possibly already an incomplete registration in the SFR with the correct date of injury. This potential double registration must be adjusted manually. But as a reminder of missing operations, we think that the function is more on the positive side than on the negative. The register management is happy to receive viewpoints from the users! The next step will be to link data on periprosthetic fractures. We are well aware of an underreporting to the SAR of such fractures when they are treated with internal fixation only. But also these cases – when the prosthesis is left in place – are to be registered in the SAR! A periprosthetic fracture is a serious complication of arthroplasty, associated with risks for the patient, and important to measure.

The most common stem components in fracture patients

	2010–2020	2010	2019	2020
Number	19,056	6,047	6,533	6,476
Implant (%)				
SPII standard	10,856 (57.0)	2,654 (43.9)	4,093 (62.7)	4,109 (63.5)
Exeter standard	5,378 (28.2)	1,846 (30.6)	1,842 (28.2)	1,690 (26.1)
MS-30 polished	953 (5.0)	238 (3.9)	346 (5.3)	369 (5.7)
Covision straight	498 (2.6)	273 (4.5)	54 (0.8)	171 (2.6)
CPT	393 (2.1)	374 (6.2)	8 (0.1)	11 (0.2)
Corail standard	272 (1.4)	223 (3.7)	25 (0.4)	24 (0.4)
Spectron EF Primary	212 (1.1)	209 (3.5)	3 (0.0)	0 (0.0)
Other	163 (0.9)	81 (1.3)	49 (0.8)	33 (0.5)
Exeter long	65 (0.3)	20 (0.3)	28 (0.4)	17 (0.3)
Restoration	60 (0.3)	12 (0.2)	23 (0.4)	25 (0.4)
Bi-Metric X por HA NC	58 (0.3)	57 (0.9)	1 (0.0)	0 (0.0)
Corail coxa vara	39 (0.2)	19 (0.3)	13 (0.2)	7 (0.1)
MP proximal standard	32 (0.2)	14 (0.2)	15 (0.2)	3 (0.0)
Corail high offset	24 (0.1)	12 (0.2)	7 (0.1)	5 (0.1)
Unknown	24 (0.1)	0 (0.0)	17 (0.3)	7 (0.1)
Wagner Cone	19 (0.1)	10 (0.2)	6 (0.1)	3 (0.0)

Table 5.6.2. The most common stem components in fracture patients 2010–2020.

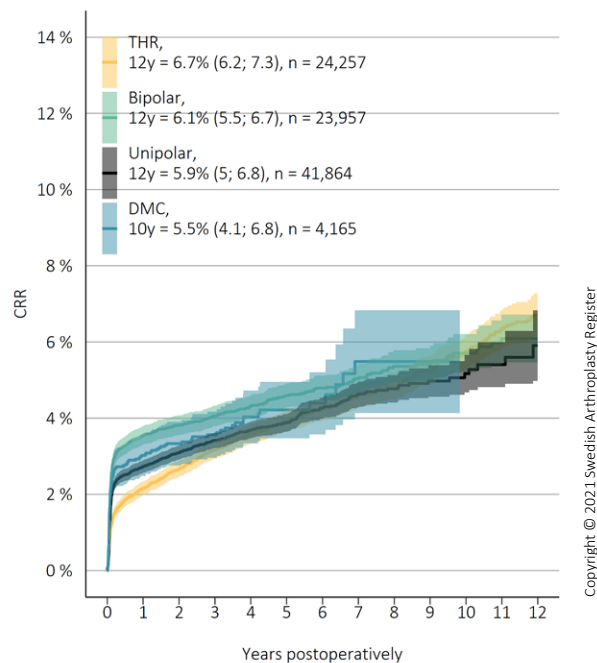


Figure 5.6.5. Type of prosthesis – cumulative risk of revision.

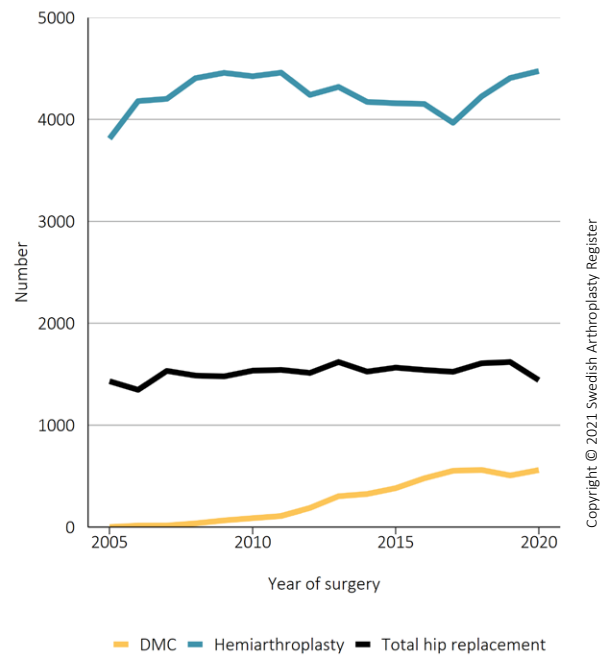


Figure 5.6.6. Choice of prosthesis in fracture-related hip arthroplasty.

The most common cup components

	2010–2020	2010	2019	2020
Number	19,056	6,047	6,533	6,476
Implant (%)				
Lubinus x-link	1,349 (23.6)	2 (0.1)	688 (32.4)	659 (33.4)
Lubinus	986 (17.2)	626 (38.6)	188 (8.8)	172 (8.7)
Avantage	785 (13.7)	56 (3.5)	373 (17.5)	356 (18.0)
Marathon	728 (12.7)	309 (19.0)	226 (10.6)	193 (9.8)
Exeter Rim-fit	586 (10.2)	10 (0.6)	320 (15.1)	256 (13.0)
Other	331 (5.8)	108 (6.7)	113 (5.3)	110 (5.6)
Polarcup cemented	253 (4.4)	30 (1.8)	94 (4.4)	129 (6.5)
ZCA XLPE	238 (4.2)	238 (14.7)	0 (0.0)	0 (0.0)
IP Link	138 (2.4)	0 (0.0)	82 (3.9)	56 (2.8)
Contemporary Hoded Duration	68 (1.2)	59 (3.6)	9 (0.4)	0 (0.0)
Trilogy	64 (1.1)	63 (3.9)	0 (0.0)	1 (0.1)
FAL	49 (0.9)	49 (3.0)	0 (0.0)	0 (0.0)
Pinnacle W/Cripton 100	39 (0.7)	0 (0.0)	21 (1.0)	18 (0.9)
Reflection XLPE	38 (0.7)	38 (2.3)	0 (0.0)	0 (0.0)
Avantage Reload	36 (0.6)	0 (0.0)	12 (0.6)	24 (1.2)
Elite Ogee	35 (0.6)	35 (2.2)	0 (0.0)	0 (0.0)

Table 5.6.3. The most common cup/head components in fracture patients 2010–2020.



Since the start in 1975 until
December 2020, 314,702 primary
knee replacements and
29,208 reoperations have been
registered in 239,839 individuals.

6. Knee replacement surgery

6.1 All knee replacements regardless of diagnosis

Authors: Annette W-Dahl and Martin Sundberg

In 2020 11,808 primary knee replacements were submitted to the registry, 30% less than during 2019 because of the pandemic. The standard treatment for a primary knee replacement is a total knee replacement (TKR), which in 2020 accounted for 87.5% of the procedures. The proportion of unicompartmental knee replacements (UKR) has increased somewhat and was 11.6% of the procedures. Other types of prosthesis (patellofemoral and partial knee replacements) were reported to a limited extent or not at all. 75 units reported to the register during the year, which includes all those who performs elective knee replacement surgery.

It shall be noted that the number of replacements may differ somewhat in different analyses as data has been extracted at different times. Table 6.1.1 shows the demographics for primary knee replacements divided into TKR and UKR.

The mean age for primary knee replacement was somewhat lower in 2020 (68.5 years) compared with 2019 (69.4 years). In a historical perspective the mean age has

increased from just over 65 years in 1975 to more than 71 years in 1994. The main reason for this increase was an increase in the number of surgeries within the older age groups. A probable explanation for this is an improved anaesthesiologic technique with increased safety for older patients and an altered age structure in society. After 1994 the proportion of patients under 65 years of age increased somewhat and the mean age decreased. This tendency has not continued in recent years, except for 2020. However, the pandemic year should be seen as a special year. Age group 65–74 years make up the largest share with 38.6% followed by the 55–64 age group (27.4%). Just over one third (35.2%) of the primary knee replacements were performed in patients under 65 years of age.

The mean age for those operated on with a UKR is more than 4 years less than those operated on with a TKR (65.6 and 69 years respectively). Almost one third (31.4%) of those operated on with a TKR were <65 years compared to that almost half (46.7%) of those operated on with a UKR were <65 years of age.

Demography TKR and UKR 2020

	TKR	UKR
Number	10,333	1,375
Age mean(SD)	68.96 (8.97)	65.58 (9.23)
Age group (%)		
< 45 years	39 (0.4)	8 (0.6)
45–54 years	579 (5.6)	164 (11.9)
55–64 years	2,625 (25.4)	470 (34.2)
65–74 years	4,013 (38.8)	490 (35.6)
75–84 years	2,792 (27.0)	223 (16.2)
85+ years	285 (2.8)	20 (1.5)
Females	5,750 (55.6)	670 (48.7)
BMI (%)		
< 18,5	17 (0.2)	0 (0.0)
18,5–24,9	1,912 (18.5)	289 (21.0)
25–29,9	4,463 (43.3)	643 (46.8)
30–34,5	3,030 (29.4)	350 (25.5)
35–39,9	782 (7.6)	84 (6.1)
≥ 40	112 (1.1)	8 (0.6)
ASA class (%)		
ASA I	1,722 (16.7)	317 (23.1)
ASA II	6,876 (66.6)	886 (64.6)
ASA III–V	1,723 (16.7)	169 (12.3)
Diagnosis (%)		
Acute trauma	10 (0.1)	0 (0.0)
Osteoarthritis	10,041 (97.2)	1,337 (97.3)
Idiopathic osteonecrosis	69 (0.7)	36 (2.6)
Inflammatory joint disease	152 (1.5)	1 (0.1)
Sequele fracture/trauma	56 (0.5)	0 (0.0)
Tumor	1 (0.0)	0 (0.0)
Other joint diseases	2 (0.0)	0 (0.0)

Table 6.1.1. Demography in TKR and UKR 2020.

Knee replacement is a more common procedure in females than in males. In the early 1980s, 70% of the operations were performed on females. Since then, the proportion of operations in males slowly increased and in 2020 they accounted for just over 44%.

There is a higher proportion of females undergoing TKR (55.6%), but there is a higher proportion of males operated on with UKR (51.3%).

The registration of BMI and ASA class for knee replacements started in 2009. The proportion of primary knee replacements in obese persons (BMI ≥ 30) is roughly the same in 2009/10 (more than 37%) as it is in 2020. On the other hand, the proportion with BMI ≥ 35 has decreased from 11% to 8.5%.

The proportion of primary TKRs in obese patients (BMI ≥ 30) is slightly higher (38.1%) than for those having UKR (32.2%). The corresponding proportions for those with BMI ≥ 35 are 8.7% for TKR and 6.7% for UKR.

The proportion of primary operations in patients classified as ASA class III–IV is roughly the same in 2020 as in 2009/10, just under 18%. Patients who had surgery with TKR were classified as ASA III–IV to a slightly greater proportion (16.7%) than those who received UKR (12.3%).

Osteoarthritis is the predominant reason for primary knee replacement (more than 97%) for both TKR and UKR. The number of operations for inflammatory joint disease, mainly rheumatoid arthritis, has by contrast decreased, especially the recent years, possibly due to the arrival of new medical treatment. Idiopathic necrosis (osteonecrosis) was a more common diagnosis in UKR (2.6%) than in TKR (0.7%).

There were 54 stabilized replacements, 45 patellofemoral replacements but no partial replacements reported in 2020. The mean age was 67.2 years for those operated on with a stabilized replacement and 63.2 years for those operated on with a patellofemoral replacement. More females than males were reported both for those operated on with a stabilized replacement (38/54) and for those with a patellofemoral replacement (35/45).

Tables 6.1.2–5 show primary knee replacements reported by the units in 2020. Topmost, the average for the whole country is shown and thereafter for each unit where the units are subdivided according to whether they are university units, privately run unit or if the number of operations was less than 100, 100–300 or more than 300. The total number of operations reported is presented in the leftmost column and the percentage of reports that were complete in the next column. The rest of the information is based only on complete reports. Please note that the percentages for units with few operations may be misleading.

Case-mix

Table 6.1.2 shows for each unit the percentage of operations that were performed for osteoarthritis (OA), were females, were younger than 55 years, had a BMI of 35 or over and were classified as ASA III or higher. Among the university units we can see that there are units reporting a higher proportion of diagnoses other than OA and ASA class \geq III while other university units do not differ from the rest of the country. The university units generally have a higher proportion of patients younger than 55 years. The privately run units generally report a lower proportion of ASA \geq III than the rest of the country except for Capio Ortopedi Motala, Capio Movement and Capio S:t Göran. The regionally run units not categorised as university are not different from the rest of the country, apart for some exceptions. For example, the proportion with a BMI of 35 and over is twice as high in Lidköping. Danderyd has more than three times the proportion of patients with ASA \geq III and Norrtälje and Uddevalla have more than twice as high a proportion with ASA \geq III as the rest of the country, while it is about half at Kullbergsska sjukhuset, in Lycksele and in Varberg. The variations in case-mix between the units is large and cannot be generalised for respective university unit, privately run unit or based on the number of operations reported.

A previous operation of the index knee (not shown in the table) was reported for 20% of the operations. Meniscal surgery is the most common (7.5%) followed by arthroscopy (4.9%), cruciate ligament surgery (2.6%), osteotomy (1.1%), osteosynthesis (0.6%) and other surgery (0.8%). For 3% of the operations more than one previous operation was stated. The previous operations reported are not comprehensive but illustrate what the surgeon knew at the time of primary replacement.

Prophylactic antibiotics

The choice of variables for prophylactic antibiotics (table 6.1.3) in the columns is based on the recommendations from the PRISS-project for the year 2020. As a Swedish study (Robertsson et al. 2017) found that patients who had been given prophylactic clindamycin had a higher risk for revision due to infection than those receiving cloxacillin, the recommendations for penicillin allergy were revised. The new recommendation (April 2018) is available at www.patientforsakringen.se. The columns “% that are given Cloxacillin/Cefotaxim/Clindamycin”, “% that are given $2\text{g} \times 3 \times 2/600\text{ mg} \times 2$ ” and “% with AB time (45–30 min)” thus shows the proportion of operations

where antibiotics has been given according to the new PRISS-recommendations. The column “% with AB-time (45–15 minutes)” shows the reported proportion of surgeries where the preoperative dose is given 45–15 minutes before the start, which was the previously recommended time interval that has been shown in earlier reports. All units report that they use Cloxacillin or corresponding as their first choice. Clindamycin has decreased as prophylaxis between 2017 and 2020 (7.5% to 4.8%). Cefotaxim is reported being used in 1.6% of surgeries. Due to the short half-life of Cloxacillin it is important that it is administered within a correct time-interval. A study from the register revealed inadequate procedures for administering prophylactic antibiotics in knee replacement (Stefánsdóttir A et al. 2009). We started to register the time for delivery of the first dose in 2009. A gradual improvement was noted in the routines and in 2011 87% of patients being reported having the dose within the recommended 45–15 minutes. Over the years 2013–2020 the proportion has however decreased to 79%.

Regarding the new recommendations for time-interval only 45% had their preoperative dose 45–30 min. prior to surgery in 2020. Only GHP Ortho Center Göteborg, Ljungby and Torsby have succeeded in implementing the latest recommendation. At these units 80% or more had their preoperative dose within 45–30 minutes before start of surgery. At Akademiska sjukhuset and Aleris Specialistvård Nacka is the adherence low to both the former and the later recommendation.

Antithrombotic prophylaxis

As there are no national or international guidelines (“best practice”) for start, choice of drug or treatment time for thrombosis prophylaxis the choice of what is presented in table 6.1.4 is based on what the hospitals reported having administrated for primary knee arthroplasties in 2020. The columns show the proportion of knee replacements where the start of prophylaxis was planned post-operatively, the proportion where a drug for injection (Dalteparin, Tinzaparin or Enoxaparin) was planned and the proportion with a planned treatment time of 8–14 days respectively. In the table we can see that the most common regime was to start the prophylaxis after surgery and that only a smaller number of units report a start before surgery. In 39% of the surgeries, it is reported that the thrombosis prophylaxis is planned as an injection or as a combination of injection and NOAC medication (Non vitamin-k Oral AntiCoagulants) (3.5%) which is lower than for 2019 (43%). In most of the surgeries (54.3%)

Case-mix per unit 2020

Unit	Number of reports	Complete reports %	OA %	Female %	< 55 year %	BMI >=35 %	ASA >= III %
Country	11,808	99.7	97	55	8	8	16
University hospitals							
Akademiska	54	100	89	57	17	13	31
Karolinska Huddinge	113	94	92	60	12	21	62
Karolinska Solna	21	95	67	48	19	19	52
SU/Möln dal	149	100	96	59	6	6	17
SU/Sahlgrenska	1						
SUS/Lund	40	100	70	68	10	18	40
Umeå	127	100	93	57	7	11	24
Private units							
Aleris Specialistvård Nacka	158	100	98	52	7	6	3
Aleris Specialistvård Ängelholm	365	100	98	55	9	10	11
Art Clinic Göteborg	186	100	100	54	13	4	1
Art Clinic Jönköping	207	100	100	50	14	6	5
Capio Artro Clinic	564	100	98	51	11	3	1
Capio Movement	488	99	100	54	9	10	19
Capio Ortopedi Motala	352	99	98	61	8	7	22
Capio Ortopediska Huset	572	100	99	60	8	3	0
Capio S:t Göran	248	100	99	58	3	8	46
Carlanderska	300	100	98	54	6	8	4
Carlanderska-SportsMed	155	100	100	25	17	14	3
Frölundaortopedien	16	100	100	19	6	6	6
GHP Ortho Center Göteborg	284	100	97	49	12	3	5
GHP Ortho Center Stockholm	640	100	98	54	8	4	2
Ortopedisk Center Sophiah.	150	99	98	40	17	7	6
Specialistcenter Scandinavia	1						
< 100 surgeries/year							
Borås	51	100	98	54	0	22	47
Eskilstuna	44	100	95	55	14	21	32
Falköping	30	100	90	70	10	7	7
Falun	55	100	93	49	2	24	29
Gällivare	63	100	98	54	2	17	37
Gävle	74	100	91	57	3	24	41
Helsingborg	32	100	100	56	3	50	59
Hudiksvall	45	100	98	51	11	7	24
Kalmar	55	100	85	62	0	0	25
Karlstad	25	100	100	56	4	0	32
Ljungby	76	100	99	63	5	11	14
Norrköping	79	100	99	57	5	5	22
Nyköping	76	96	93	55	4	5	17

Case-mix per unit 2020, cont.

Unit	Number of reports	Complete reports %	OA %	Female %	< 55 year %	BMI >=35 %	ASA >= III %
Skellefteå	68	99	100	54	4	13	9
Skene	97	100	100	56	5	4	3
Skövde	2	100	100	100	0	50	0
Sunderby sjukhus	3	67	67	67	0	0	67
Sundsvall	14	100	71	57	7	14	50
Södersjukhuset	84	100	95	51	8	21	50
Södertälje	78	100	100	60	5	14	44
Torsby	91	100	100	51	7	3	22
Visby	64	100	95	47	6	19	17
Västervik	74	100	100	62	3	11	7
Växjö	59	98	100	54	3	2	22
Örnsköldsvik	88	100	98	58	15	8	28
Östersund	93	100	98	61	6	9	19
100–300 surgeries/year							
Alingsås	115	100	99	57	3	13	17
Arvika	141	100	99	51	1	1	16
Bollnäs	250	100	95	54	8	3	14
Danderyd	120	100	97	53	9	13	57
Eksjö	240	100	97	61	8	5	18
Halmstad	154	98	98	53	5	14	25
Karlshamn	173	100	97	55	6	8	12
Kullbergsska sjukhuset	236	99	99	53	7	12	9
Kungälv	108	100	94	53	9	10	13
Lidköping	130	100	92	58	5	17	25
Lindesberg	272	100	98	56	8	7	17
Lycksele	144	99	94	55	13	13	8
Mora	168	100	99	59	7	15	19
Norrtälje	134	100	98	52	7	14	32
Oskarshamn	253	100	97	52	6	11	17
Piteå	258	100	96	60	8	9	19
Sollefteå	115	100	98	58	2	5	20
Uddevalla	153	100	98	61	1	9	33
Varberg	143	99	97	50	6	8	9
Värnamo	135	100	98	53	1	11	24
Västerås	119	100	90	62	8	4	26
Ängelholm	156	100	97	64	10	12	28
>300 surgeries/year							
Enköping	336	100	98	57	5	9	12
Hässleholm	650	100	93	56	8	6	17
Trelleborg	375	100	97	58	8	11	21

Table 6.1.2. Case-mix per unit 2020.

Prophylactic antibiotics per unit 2020

Unit	Number of reports	Complete reports %	Percent having Cloxacillin, Cefotaxim or Clindamycin %	Percent having dosage 2g × 3, 2g × 2 or 600 mg × 2 %	Percent AB time within (45–15 min) %	Percent AB time within (45–30 min) %
Country	11,808	99	99.7	96	79	45
University hospitals						
Akademiska	54	96	98	78	35	7
Karolinska Huddinge	113	86	90	78	56	32
Karolinska Solna	21	100	100	90	81	57
SU/Möln dal	149	99	100	95	72	47
SU/Sahlgrenska	1					
SUS/Lund	40	100	100	90	65	45
Umeå	127	97	96	93	76	36
Private units						
Aleris Specialistvård Nacka	158	99	100	95	46	30
Aleris Specialistvård Ängelholm	365	99	100	98	81	9
Art Clinic Göteborg	186	99	100	99	72	6
Art Clinic Jönköping	207	100	100	97	92	22
Capio Artro Clinic	564	100	100	97	86	55
Capio Movement	488	99	100	91	74	45
Capio Ortopedi Motala	352	100	100	99	89	60
Capio Ortopediska Huset	572	99	100	98	82	31
Capio S:t Göran	248	100	100	98	91	38
Carlanderska	300	97	100	99	83	39
Carlanderska-SportsMed	155	99	100	99	91	44
Frölundaortopedien	16	100	100	94	94	19
GHP Ortho Center Göteborg	284	99	100	96	89	80
GHP Ortho Center Stockholm	640	100	100	99	96	77
Hermelinen	19	100	100	100	68	0
Ortopedisk Center Sophiah.	150	94	100	93	69	47
Specialistcenter Scandinavia	1					
< 100 surgeries/year						
Borås	51	100	100	100	63	43
Eskilstuna	44	100	100	98	64	2
Falköping	30	100	100	100	47	43
Falun	55	100	100	96	82	47
Gällivare	63	98	100	95	83	41
Gävle	74	100	100	88	77	35
Helsingborg	32	97	100	75	69	41
Hudiksvall	45	98	100	89	69	31
Kalmar	55	100	100	95	84	49
Karlstad	25	100	100	100	72	60
Ljungby	76	100	100	93	91	88
Norrköping	79	99	99	99	62	51
Nyköping	76	99	100	100	79	55

Prophylactic antibiotics per unit 2020, cont.

Unit	Number of reports	Complete reports %	Percent having Cloxacillin, Cefotaxim or Clindamycin %	Percent having dosage 2g × 3, 2g × 2 or 600 mg × 2 %	Percent AB time within (45–15 min) %	Percent AB time within (45–30 min) %
Skellefteå	68	99	94	91	78	59
Skene	97	98	100	97	64	48
Skövde	2	100	100	100	50	0
Sunderby sjukhus	3	67	100	67	33	33
Sundsvall	14	100	100	93	100	57
Södersjukhuset	84	99	99	93	58	38
Södertälje	78	95	100	92	68	44
Torsby	91	100	100	100	95	92
Visby	64	98	100	98	84	36
Västervik	74	100	100	99	73	55
Växjö	59	98	100	97	83	27
Örnsköldsvik	88	100	100	100	61	44
Östersund	93	99	100	100	77	41
100–300 surgeries/year						
Alingsås	115	99	100	99	63	57
Arvika	141	100	100	99	70	44
Bollnäs	250	100	100	98	90	42
Danderyd	120	98	98	93	66	42
Eksjö	240	100	100	98	88	62
Halmstad	154	99	99	94	73	48
Karlshamn	173	100	100	99	80	43
Kullbergsska sjukhuset	236	99	100	98	78	50
Kungälv	108	99	100	96	69	57
Lidköping	130	100	100	98	91	49
Lindesberg	272	100	100	96	79	49
Lycksele	144	98	100	94	78	51
Mora	168	99	100	93	81	60
Norrtälje	134	99	100	93	74	44
Oskarshamn	253	98	99	94	80	59
Piteå	258	100	100	96	91	48
Sollefteå	115	98	100	100	79	51
Uddevalla	153	100	100	97	71	59
Varberg	143	99	100	89	70	43
Värnamo	135	100	100	98	91	43
Västerås	119	99	100	93	86	51
Ängelholm	156	100	100	98	76	43
>300 surgeries/year						
Enköping	336	100	100	96	89	52
Hässleholm	650	100	100	97	59	12
Trelleborg	375	100	100	98	80	39

Table 6.1.3. Prophylactic antibiotics per unit 2020.

Antithrombotic prophylaxis per unit 2020

Unit	Number of reports	Complete reports %	Percent starting postop %	Percent having injection %	Percent treated for 8–14 days %
Country	11,808	98.4	90	39	72
University hospitals					
Akademiska	54	85	93	6	63
Karolinska Huddinge	113	85	89	83	50
Karolinska Solna	21	95	95	95	14
SU/Möln dal	149	99	99	5	97
SU/Sahlgrenska	1				
SUS/Lund	40	98	90	98	50
Umeå	127	98	82	23	98
Private units					
Aleris Specialistvård Nacka	158	99	99	99	93
Aleris Specialistvård Ängelholm	365	98	90	0	94
Art Clinic Göteborg	186	98	99	100	92
Art Clinic Jönköping	207	100	100	0	99
Capio Artro Clinic	564	99	100	3	96
Capio Movement	488	99	99	99	0
Capio Ortopedi Motala	352	99	52	53	49
Capio Ortopediska Huset	572	100	100	0	97
Capio S:t Göran	248	99	85	94	83
Carlanderska	300	99	95	6	88
Carlanderska-SportsMed	155	99	97	2	98
Frölundaortopedien	16	100	100	0	100
GHP Ortho Center Göteborg	284	100	100	1	96
GHP Ortho Center Stockholm	640	100	100	1	99
Hermelinen	19	100	100	0	0
Ortopedisk Center Sophiah.	150	96	97	99	67
Specialistcenter Scandinavia	1				
< 100 surgeries/year					
Borås	51	96	98	0	90
Eskilstuna	44	95	95	2	91
Falköping	30	100	100	3	100
Falun	55	98	100	100	5
Gällivare	63	92	97	5	79
Gävle	74	96	96	21	81
Helsingborg	32	81	97	19	63
Hudiksvall	45	98	98	98	89
Kalmar	55	98	55	58	47
Karlstad	25	100	92	8	88
Ljungby	76	93	97	3	88
Norrköping	79	100	29	38	28
Nyköping	76	99	97	1	92

Antithrombotic prophylaxis per unit 2020, cont.

Unit	Number of reports	Complete reports %	Percent starting postop %	Percent having injection %	Percent treated for 8–14 days %
Skellefteå	68	100	100	4	100
Skene	97	100	100	2	97
Skövde	2	100	100	0	100
Sunderby sjukhus	3	100	33	100	100
Sundsvall	14	100	100	14	93
Södersjukhuset	84	99	96	96	87
Södertälje	78	99	92	97	64
Torsby	91	99	100	5	90
Visby	64	95	97	5	70
Västervik	74	100	9	12	7
Växjö	59	98	98	8	93
Örnsköldsvik	88	100	95	11	86
Östersund	93	99	90	89	87
100–300 surgeries/year					
Alingsås	115	100	92	2	99
Arvika	141	99	100	100	94
Bollnäs	250	98	100	100	94
Danderyd	120	96	89	39	78
Eksjö	240	100	19	21	18
Halmstad	154	100	88	100	1
Karlshamn	173	95	100	95	86
Kullbergsska sjukhuset	236	97	99	3	94
Kungälv	108	100	97	2	91
Lidköping	130	100	100	0	93
Lindesberg	272	100	100	23	67
Lycksele	144	91	4	100	91
Mora	168	99	99	1	96
Norrtälje	134	100	99	99	78
Oskarshamn	253	99	43	46	39
Piteå	258	100	85	100	92
Sollefteå	115	98	98	98	87
Uddevalla	153	98	99	7	92
Varberg	143	99	93	99	84
Värnamo	135	99	44	46	38
Västerås	119	99	97	7	84
Ängelholm	156	97	97	17	93
>300 surgeries/year					
Enköping	336	96	99	2	89
Hässleholm	650	100	98	100	14
Trelleborg	375	100	96	100	6

Table 6.1.4. Antithrombotic prophylaxis per unit 2020.

Surgical technique 2020

Unit	Number of reports	Complete reports %	Percent having general anesthesia %	Percent drainage %	Percent tourniquet %	Percent LIA %	Median Op time
Country	11,808	99	35	<0.2	31	97	66
University hospital							
Akademiska	54	98	28	0	69	93	85
Karolinska Huddinge	113	82	20	1	52	91	98
Karolinska Solna	21	95	19	29	76	71	99
SU/Möln dal	149	99	21	0	4	93	84
SU/Sahlgrenska	1						
SUS/Lund	40	90	63	0	13	90	86
Umeå	127	96	21	1	72	91	101
Private units							
Aleris Specialistvård Nacka	158	98	99	0	1	92	40
Aleris Specialistvård Ängelholm	365	99	98	0	1	98	41
Art Clinic Göteborg	186	99	100	0	5	95	61
Art Clinic Jönköping	207	100	99	0	8	100	65
Capio Artro Clinic	564	99	86	0	15	95	59
Capio Movement	488	99	1	0	4	100	52
Capio Ortopedi Motala	352	100	6	1	20	99	65
Capio Ortopediska Huset	572	100	5	0	39	99	48
Capio S:t Göran	248	98	11	0	94	96	58
Carlanderska	300	99	10	0	3	98	67
Carlanderska-SportsMed	155	99	6	0	9	99	42
Frölundaortopedien	16	94	100	0	0	94	62
GHP Ortho Center Göteborg	284	99	7	0	0	89	80
GHP Ortho Center Stockholm	640	99	2	0	10	97	60
Hermelinen	19	100	0	0	0	100	60
Ortopedisk Center Sophiah.	150	92	89	4	47	92	65
Specialistcenter Scandinavia	1						
< 100 surgeries/year							
Borås	51	100	12	0	78	96	86
Eskilstuna	44	100	7	0	0	100	102
Falköping	30	100	13	0	3	97	87
Falun	55	100	18	4	95	100	68
Gällivare	63	100	3	0	10	100	95
Gävle	74	100	41	0	97	96	73
Helsingborg	32	100	22	0	0	97	75
Hudiksvall	45	96	27	0	7	82	79
Kalmar	55	100	20	0	0	91	85
Karlstad	25	100	28	0	0	100	68
Ljungby	76	99	93	0	33	100	63
Norrköping	79	100	29	0	10	96	92
Nyköping	76	99	7	0	29	100	90

Surgical technique 2020, cont.

Unit	Number of reports	Complete reports %	Percent having general anesthesia %	Percent drainage %	Percent tourniquet %	Percent LIA %	Median Op time
Skellefteå	68	100	3	0	100	100	86
Skene	97	100	16	0	86	100	84
Skövde	2	100	0	0	0	50	92
Sunderby sjukhus	3	100	0	0	67	67	88
Sundsvall	14	100	7	0	0	100	116
Södersjukhuset	84	98	8	0	0	79	85
Södertälje	78	99	82	0	1	99	70
Torsby	91	100	11	0	14	100	80
Visby	64	100	17	0	0	100	109
Västervik	74	100	31	0	0	95	71
Växjö	59	97	39	0	8	97	66
Örnsköldsvik	88	99	8	0	95	94	80
Östersund	93	100	22	0	95	100	83
100–300 surgeries/year							
Alingsås	115	100	14	0	0	95	91
Arvika	141	99	6	0	1	100	66
Bollnäs	250	100	94	0	75	97	56
Danderyd	120	97	15	0	71	97	89
Eksjö	240	100	23	0	20	100	66
Halmstad	154	99	12	0	77	99	87
Karlshamn	173	100	91	0	88	97	73
Kullbergsska sjukhuset	236	100	10	0	29	96	62
Kungälv	108	99	32	0	19	95	81
Lidköping	130	100	12	0	0	99	78
Lindesberg	272	100	99	0	1	98	71
Lycksele	144	94	8	0	94	99	85
Mora	168	99	10	0	99	92	60
Norrtälje	134	100	30	0	74	91	80
Oskarshamn	253	98	14	0	63	92	72
Piteå	258	100	2	0	98	99	55
Sollefteå	115	99	15	0	75	100	75
Uddevalla	153	99	9	0	1	99	89
Varberg	143	100	14	0	6	94	83
Värnamo	135	100	9	0	0	90	86
Västerås	119	100	4	0	0	92	59
Ängelholm	156	100	75	0	0	97	74
>300 surgeries/year							
Enköping	336	99	12	0	82	100	74
Hässleholm	650	100	87	0	1	100	38
Trelleborg	375	99	34	0	41	100	66
Total	11,797	99	35	<0,2	31	97	66

Table 6.1.5. Surgical technique per unit 2020.

NOAC was planned as the sole thrombosis prophylaxis. In previous reports the proportion receiving an injection has varied between 63–83%. The duration of planned thrombosis prophylaxis has been relatively similar over the years since the variable started to be recorded in 2009 (see previous reports) and about 72–79% of operations have a planned prophylaxis period of 8–14 days. On the other hand, the proportion of operations reported to have a shorter prophylaxis (1–7 days) has decreased slightly in 2019 to 2020, from 19% to 16%, while the proportion reported to receive no prophylaxis at all has increased in 2020 compared to 2019 from 4% to 6%.

Surgical technique

There are no national or international guidelines (“best practice”) considering the use of “surgical technique” that are registered. In table 6.1.5 the proportion of surgeries where the use of general anaesthesia, a tourniquet, drainage and LIA (local infiltration anaesthesia) with or without remaining catheter are given as well as the median operating time for each unit. Spinal anaesthesia is the most common anaesthetic form (65%) and the increase in use of general anaesthesia has stagnated (31.6% in 2017 and 34.6% in 2020). 13 units reported that they performed more than 80% of the operations in general anaesthesia. The use of a drainage has decreased from 26% in 2011 to <0.2%. In 2020 more surgeries were performed without the use of a tourniquet than before; a gradual decrease from 90% in 2011 to just over 31% in 2020. LIA, with or without a remaining catheter, was as previously reported used for the vast majority of the surgeries. The median time for a primary knee replacement (without considering fixation or type of prostheses) varied between the units

Type of arthrotomy in UKR

Modell	Standard incision, n	Mini insision, n	Unknown, n
Ibalance	0	10	0
Link	148	9	2
Oxford	419	420	6
Persona-PK	43	4	0
Sigma-PKR	57	1	0
Triathlon Uni	125	6	0
ZUK	99	24	0
Missing	2	0	0
Total	893	474	8

Table 6.1.6. Type of arthrotomy in UKR.

from 38 to 116 minutes. Overall, the median time for a TKR was 67 minutes, for a UKR 59 minutes, for a patello-femoral replacement 67 minutes and for a hinged/stabilized replacement 138 minutes. Since 2009 the median time for TKR has varied between 67 and 82 minutes and for UKR between 59 and 80 minutes. Bone grafting rarely occurs in primary operations and almost exclusively autologous when reported. Bone grafting was reported in <1% of operations and was slightly more common in the femur (61%) than the tibia (54%). Computer Assisted Surgery (CAS) were reported in 2 operations from one unit. No UKRs were reported performed with CAS. Custom made instruments/sawing blocks were reported at 8 operations in 2020 which is less than reported in 2019 (64 operations). The technique was reported from 2 units of which Lindesberg reported 7 of them.

Arthrotomy

Since 1999 we have registered if the technique of minimally invasive surgery (MIS) was used. We define it as a small arthrotomy (with no specific limit on length) where the operation is performed without evertting the patella. While the use of MIS in TKR is rare, the popularity of MIS in UKR increased rapidly during the late 90s and reached its peak in 2007 when 61% of all UKRs were reported to be operated on with MIS. Some prosthetic models, especially Oxford, are more often used with MIS than others. In 2020 MIS was reported in 34.7% of the UKR but only in 0.2% of the TKRs (table 6.1.6).

Fixation

The use of cement remains by far the most common method of fixation the components to bone. Cementless fixation, however, continues to increase. In 2010 2.4% of all TKRs were reported to be fixated without cement and by 2020 8.7% were reported as completely cementless. 2020 was 0.3% of all TKRs hybrids (figure 6.1.1). In UKR, the change has been significant in recent years. Before 2010 almost all UKRs were cemented but since 2013 this has changed. In 2020 58.5% of the UKRs were inserted without cement and 1.1% were hybrids (figure 6.1.2). The reason for this is mainly the popularity of Oxford cementless type which was used in 94% of Oxford cases.

Figure 6.1.3 shows the proportion of fixation type in each county for TKR due to osteoarthritis in 2020. The Region of Skåne reports cementless fixation in almost half of all TKRs (48%), while most of the counties report no or a small proportion of cementless TKRs.

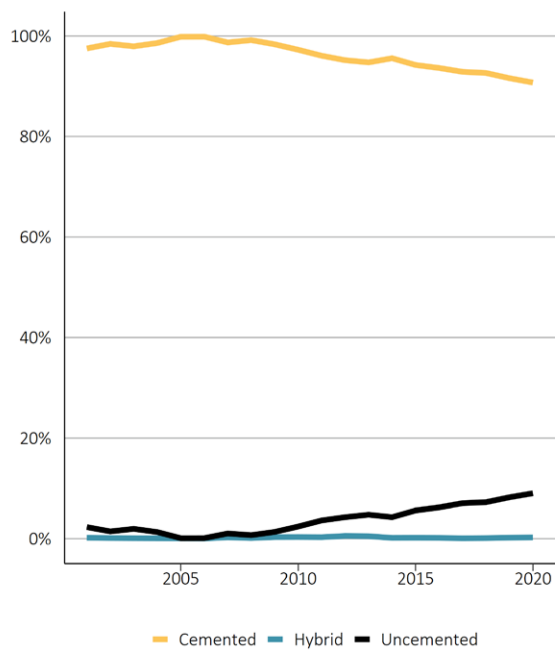


Figure 6.1.1. Time trend for method of fixation, TKR/OA.

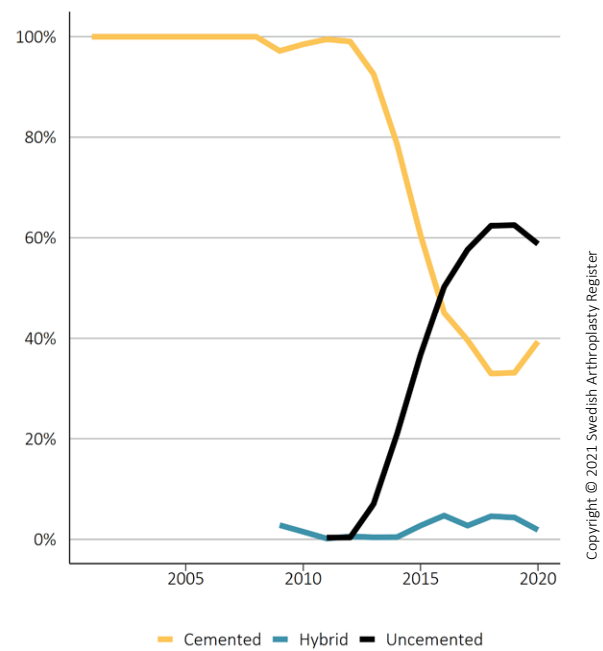


Figure 6.1.2. Time trend for method of fixation, UKR/OA.

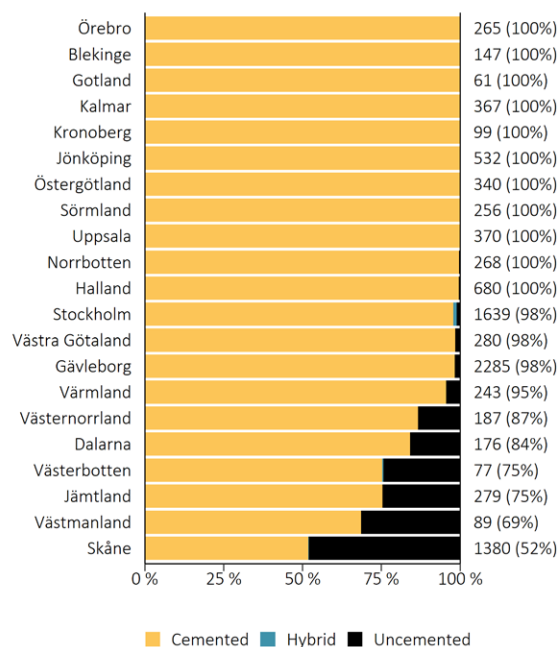


Figure 6.1.3. The relative use of fixation type in TKR/OA.

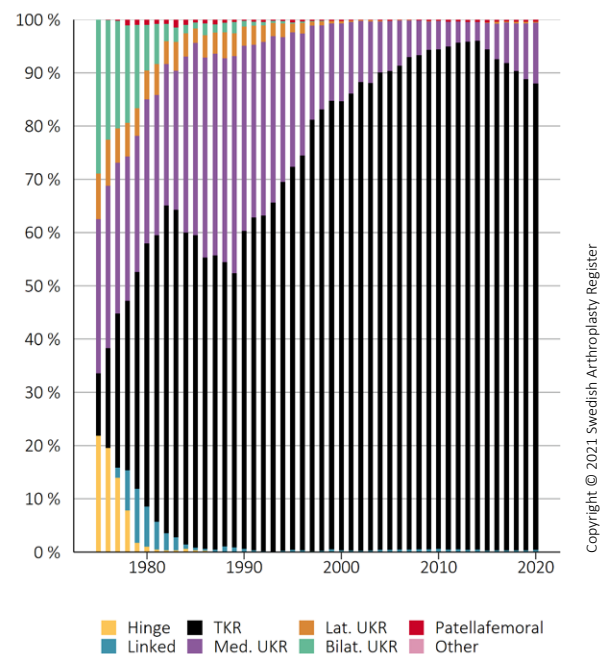


Figure 6.1.4 Distribution of type of prosthesis in primary surgery 1975–2020.

Type of cement

Type of bone cement	Number TKR	Proportion (%) TKR	Number UKR	Proportion (%) UKR
Type unknown	42	0	5	1
CMW with Gentamicin	0	0	15	3
Copal (genta+clinda)	6	0	1	0
Copal (genta+vanco)	6	0	0	0
Optipac Refobacin	4,164	44	157	27
Palacos R+G (gentamicin)	722	8	112	19
Palacos R+G Pro(prefilled)	3,743	40	201	35
Refobacin Bone Cement (genta)	614	7	70	12
Refobacin Revision Cement (genta+clinda)	6	0	0	0
Smartset GHV (gentamicin)	86	1	16	3
Missing	1	0	0	0
Total	9,39	100	577	100

Table 6.1.7. Type of cement in TKR and UKR 2020.

Cement

Since 2007 there is a label with article number for the cement to almost all operations where cement has been used, which is why cement types can be reliably identified (table 6.1.7). As the type of mixing system is likely to have an effect on the quality of the cement, we are also interested in the article numbers of these, that is whether separate mixing systems with their own article numbers have been used. Practically all the cement that was reported in 2020 in primary operations contained antibiotics of the gentamicin type.

Implants

TKR was developed during the 1970s when there were already hinged prostheses and UKRs. When the Swedish Knee Arthroplasty Register started registration in 1975, TKR had just been introduced in Sweden and therefore hinged prostheses and UKR were used for the majority of the primary operations (figure 6.1.4). It was also common to combine two UKRs in the same knee (bilateral UKR) in cases where the knee disease affected more than one compartment. When the use of TKR spread, bilateral UKRs ceased to be used. Nowadays, hinged, linked and stabilized prostheses are used mainly for difficult primary cases, trauma, tumours and revisions. For uncomplicated primary cases, TKR is mostly used, but also UKR in some cases of unicompartmental disease. The use of UKR gradually decreased between 1990 and 2015 but has since

gradually increased again. The use of UKR on the lateral side of the knee has been very rare since the mid-90s. The reason for the decline in popularity of UKR may be that compared to TKR, UKR has been shown to have a considerably higher revision rate (see figure 6.4.6). On the other hand, it must be taken into account that parts of the knee in UKR, do not have been replaced with a prosthesis and may later suffer from disease. This means that it may be tempting to offer revision of UKR to TKR for patients with pain of unclear nature and unclear cause. In favour of UKR, however, is the risk of revision due to infection which is significantly lower than for TKR (RR 0.5) as is the risk of revision with stabilized implants, arthrodesis or amputation (see table 6.4.2 a-c).

Prosthesis model

The prosthesis model is probably the factor that generates the most interest and is most often related to the outcome of knee replacement surgery. However, it is not only the model/design that determines whether the knee replacement needs to be reoperated, but also the so-called “case-mix”. The Swedish Joint Arthroplasty Register tries in its analyses to reduce the case-mix effect by taking into account factors such as the patients’ disease, sex, age and the time period in which the operation were performed.

Another important factor that the register is not able to include in its analyses, is the surgical experience of the

individual surgeon. It is obvious that surgeons can be more or less skilled at operating which can affect the results of individual implants, especially when the use has been limited to a few surgeons and units. Therefore, it could be discussed if it is fair to report results for specific models when it can be argued that deviant results may be influenced by the skill of the surgeon. To this we can only say that the risk of revision for the individual model is the result of what the users have been able to achieve with that particular model. The final result is determined by the prosthesis design, materials, durability, accompanying instruments, ease of use, safety margins (how the model behaves if it is not inserted in the exact position) together with the skill of the surgeon and training in the use of the instruments/prosthesis, and to select appropriate patients for this particular surgery. Producers together with the distributors have the opportunity to influence most of these factors. Therefore, it cannot be considered wrong to associate the model with the results even if the results do not depend solely on design, materials and durability.

Historically, the most used knee replacement models in Sweden have been among those with the lowest revision rate. This may be because the surgeons have been able to select the best designs, but also because when the same implants are used often, surgical habits become strong.

The models that showed a significantly worse result than the others have mostly disappeared from the Swedish market. An exception was the Oxford UKR which initially had inferior results but after modifications and with increased surgical experience recovered leading to continued use.

Table 6.1.8a shows TKR (including revision models) and 6.1.8b UKR implants used in primary surgery 2020. Table 6.1.8a does not include 53 linked prostheses reported in primary surgery, mainly rotations models (Link Endo, MUTARS, NexGen, S-ROM Noiles, Smith & Nephew and Stryker) for the treatment of malignancies, fractures and other special cases.

The same 3 models as last year dominate. NexGen from Zimmer accounts for just over half (54.9%) of implants while PFC from DePuy accounts for just under 18.5% and Triathlon from Stryker accounts for 16.6%.

After several years of decline in the use of UKR its use has increased since 2014. In 2020 UKR accounted for 11.6% of the primary replacements (10.3% in 2019). The Oxford-model was used for 61.5% of the procedures in 2020 which is a slightly lower proportion than in 2019.

Most common TKR implant

Model	Number	Proportion (%)
Attune MB TKR	13	0.13
Duracon Bi/Tri unpec.	3	0.03
Genesis II MBT	254	2.46
Journey TKR	9	0.09
Legion / Genesis II Revision	11	0.11
Legion/Genesis II Pri MBT	293	2.84
NexGen MBT	5,35	51.78
NexGen Revision	45	0.44
NexGen Trabecular Metal	278	2.69
Persona TKR	411	3.98
Persona TKR Trabecular Metal	33	0.32
PFC constrained (rev not TC3)	3	0.03
PFC Sigma TC-3 (revision)	46	0.45
PFC Sigma TKR APT	202	1.95
PFC Sigma TKR MBT	1,656	16.03
PFC Sigma TKR Rotating platform	3	0.03
PFC Sigma TKR unspec	1	0.01
Triathlon MBT	1,606	15.54
Triathlon Total Stabilizer	105	1.02
Missing	11	0.11
Total	10,333	100

Table 6.1.8a. Most common TKR implants (including revision models) in primary surgery 2020.

Most common UKR implant

Model group	Number	Proportion (%)
Ibalance	10	1
Link	159	12
Oxford	845	61
Persona-PK	47	3
Sigma-PKR	58	4
Triathlon Uni	131	10
ZUK	123	9
Missing	2	0
Total	1,375	100

Table 6.1.8b. Most common UKR implants in primary surgery 2020.

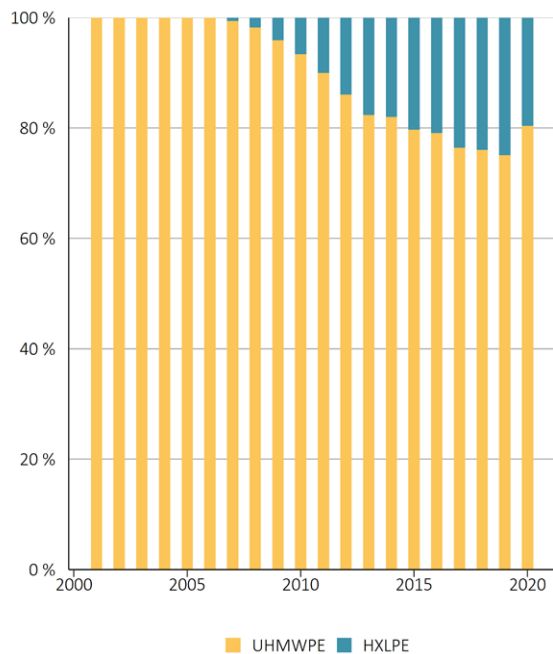


Figure 6.1.5. Distribution of the old UHMWPE polyethylene and the new cross-linked HXLPE polyethylene types.

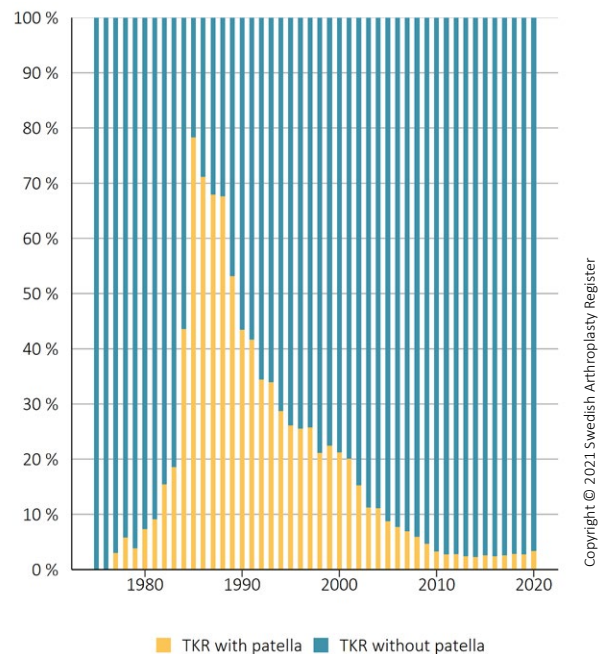


Figure 6.1.6. Distribution of TKR with or without patella component.

Use of patella component

Model	Number TKR without patella	Proportionl (%) TKR without patella	Number TKR with patella	Proportion (%) TKR with patella
Attune MB TKR	9	69.2	4	30.8
Genesis II MBT	249	98.0	5	2.0
Journey TKR	9	100	0	0
Legion/Genesis II Pri MBT	260	88.7	33	11.3
NexGen MBT	5,268	98.5	82	1.5
NexGen Revision	44	97.8	1	2.2
NexGen Trabecular Metal	270	97.1	8	2.9
Persona TKR	410	99.8	1	0.2
Persona TKR Trabicular Metal	27	81.8	6	18.2
PFC Sigma TC-3 (revision)	40	86.9	6	13.0
PFC Sigma TKR APT	194	96.0	8	4.0
PFC Sigma TKR MBT	1,548	93.5	108	6.5
PFC Sigma TKR Rotating platform	2	66.7	1	33.3
Triathlon MBT	1,537	95.7	69	4.3
Triathlon Total Stabilizer	95	90.5	10	9.5
Other	14	77.8	4	22.2
Total	9,976		346	

Table 6.1.9. The use of patella component in primary TKR 2020.

Types of polyethylene

Figure 6.1.5 shows that the Swedish orthopaedic surgeons relatively late have begun to replace the well-proven UHMWPE polyethylene with the newer highly cross-linked types (HXLPE). 2006 when the new polyethylene variants started to be used in Sweden they were already being used in Australia for a quarter of cases according to their latest annual report (AOANJRR) (<https://aoanjrr.sahmri.com>).

96% of implants using HXLPE polyethylene in Sweden until 2020 have been Triathlon (X3 polyethylene) or PFC (XLK polyethylene). So far, we have not been able to note a reduced revision rate for the Triathlon or PFC implants using HXLPE polyethylene. However, AONJRR has previously reported lower revision rates for HXLPE polyethylene (Steiger et al. 2015) but this was prosthesis-dependent and applied to NexGen and Natural II but not to Triathlon or Scorpio NRG; data on PFC were not included.

It is important to remember that the methods for increasing the durability of the new plastics by radiation and/or addition of antioxidants are very different. For many plastics the effect on the revision rate in the longer term remains to be seen.

Patella component in TKR

In the 1980s, a patella component was used in just over half of the TKR cases. Since then, its use has decreased so much so that in 2020 it was only used in just over 3% of the TKR cases (figure 6.1.6 and table 6.1.9). The use has previously been strongly associated with which prosthesis models used. The differences have decreased while the use of patellar components has become rarer. In 2020, patellar components were used proportionally more often with Legion/Genesis II and PFC. In Sweden, females are slightly more likely than males to have their patella resurfaced in TKR. This has been explained by the fact that femuropatellar symptoms were more common in females. In 2020, 1.1% of males had their patella resurfaced compared with 2.3% of females. The relative use of a patella component in the different age groups in 2020 shows that the use of patellar components is slightly more common in the youngest age groups (figure 6.1.7). The proportions however have varied slightly due to the existence of relatively few young patients. A discussion if it affects the revision rate, whether a patella component is used or not, are available along with CRR curves (figures 6.4.11 and 6.4.12) showing how the effect has changed over time.

Cruciate ligament retaining and cruciate ligament sacrificing TKR

There are cruciate ligament sacrificing types of TKRs which stabilises the knee, usually with an eminence in the middle part of the tibial polyethylene, that goes into a box in the femoral component between the medial and lateral gliding surfaces, however allowing some rotation. The type is called “posterior stabilized” (PS) and requires resection of the posterior cruciate ligament. Those advocating the use of PS claim that it provides increased flexion and more normal knee movement than the “cruciate retaining” (CR) type which spares the posterior cruciate ligament.

The disadvantage of PS is that the increased stability stresses on the polyethylene and bone surfaces and thus theoretically increases the risk of wear and loosening. PS implants have been popular in other countries such as the USA. However, they have not been used much in Sweden as CR implants have been preferred, at least for those knees that are without major malalignment and that have an intact posterior cruciate ligament.

Pending the validation of the component database is not yet complete we will have to wait with information in this section and present it in the online version of this year's report.

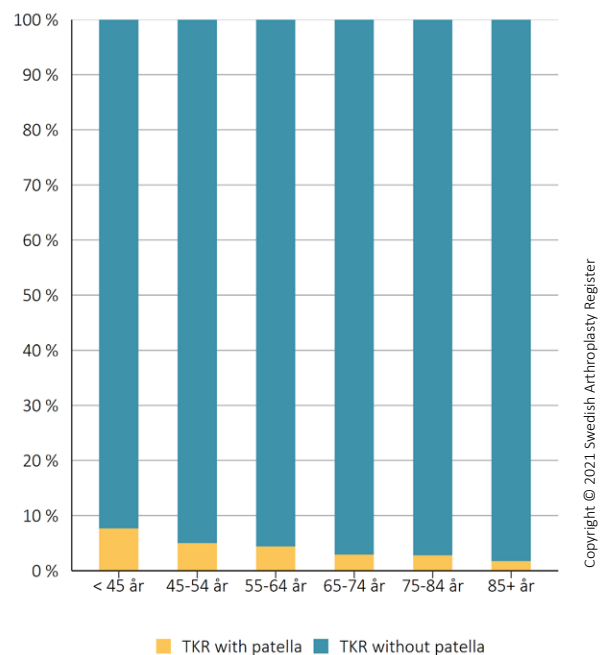


Figure 6.1.7. Distribution of the use of patella component in the different age groups 2020.

6.2 Reoperation of knee replacements regardless of primary diagnosis, cause of reoperation or previous reoperations

Authors: Martin Sundberg and Annette W-Dahl

Reoperation includes all types of procedures that can be related to a previously inserted knee replacement, regardless of whether components are inserted, any of the components are replaced, removed (including arthrodesis and amputation) or left untouched. The number of reoperations has increased year by year as the number of primary operations have increased and slightly more from 2013 apart from the pandemic year 2020 (figure 6.2.1). The reason for the recent increase is likely to be that prior to 2013 procedures other than those defined as revision (components are replaced, added or removed) were not requested when reporting knee replacement surgery but were recorded if they were sent to the register. The surgical year 2020 is the first year the reoperation variable is reported. It should be noted that other interventions are not well-defined as opposed to revision. It is difficult to determine to what extent these are reported and thus may affect outcomes and disadvantage units that are good at

reporting other interventions. The relative proportion of reoperations has decreased since the early 1990s and then increased again in 2012–2014 (figure 6.2.2). The reason is probably the same as described above, as well as the fact that the proportion of primary operations has increased considerably.

Figure 6.2.3 shows the distribution of primary operations and reoperations reported per unit in 2020. The number and proportion of primary operations are shown in the column on the right. Units with fewer than 20 operations have been excluded. The proportion of reoperations per unit varies from SUS/Lund where more than half of the operations are reported as reoperations to units that have reported no reoperations at all. The variation may be due, for example, to primary operations being performed in one or more units in a region while reoperations are concentrated in another unit in the region.

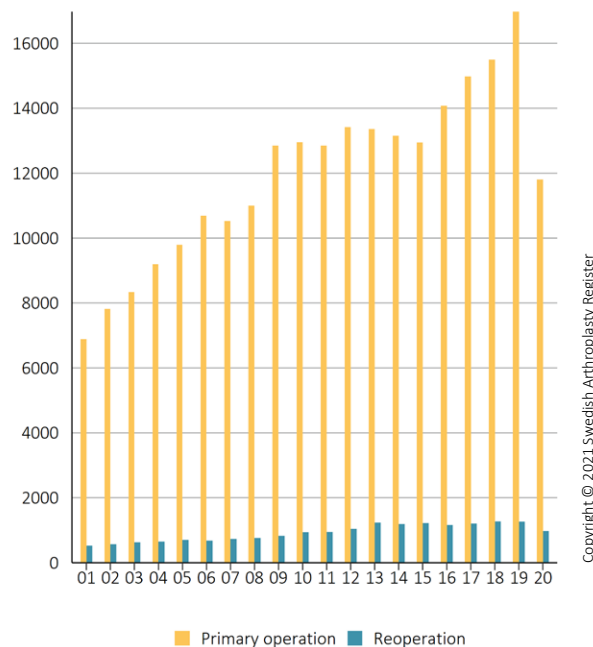


Figure 6.2.1. Number of primary and reoperations per year 2001–2020.

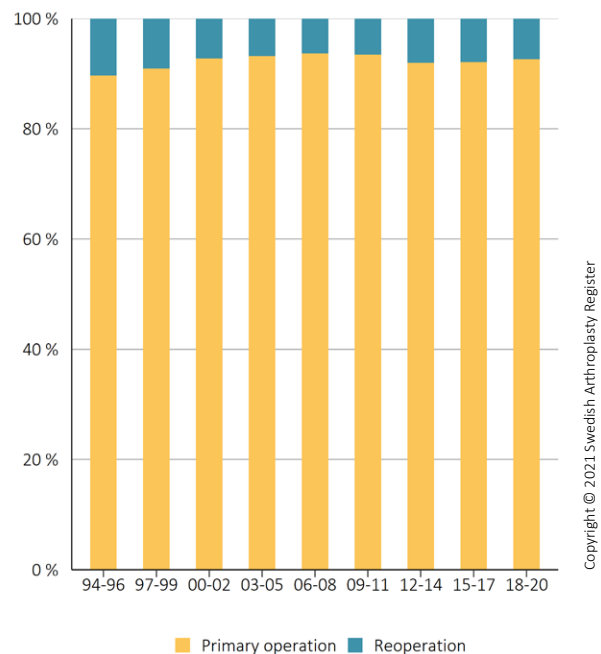


Figure 6.2.1. Distribution of primary knee replacements and reoperations (revision + other procedures) 1995–2020 divided in three-year periods.

The mean age at reoperation was more than half a year higher and a slightly higher proportion of males than at primary surgery in 2020 (table 6.2.1). The age groups 65 years and older were slightly more represented at reoperation compared to primary surgery. In reoperation, the proportion increases in BMI classes defined as obese (≥ 30), in ASA class $\geq III$ and in diagnoses other than osteoarthritis (diagnosis from the primary surgery).

The most common reasons for reoperation in the last 10 years for TKR/OA, TKR/RA and UKR/OA is shown in figure 6.2.4. For TKR/OA, infection is now more common reason for reoperation than loosening, which has dominated in the past. The reason for reoperation “progress” in TKR refers to, in principle, femoropatellar osteoarthritis. The reason for reoperation “patella” includes all kinds of patellar problems in replacements both with or without a patellar component (but not loosening or wear of the patellar component). Not that the distribution of reason for reoperation does not necessarily reflect the risk of these complications. As the number of primaries in TKR/OAs has increased considerably over time, early reoperations are over-represented, such as infections and joint contracture. The reason for reoperation differs slightly between TKR/OA and TKR/RA with a higher proportion of fractures for RA patients, but a lower proportion of reoperations due to joint contracture. For UKR/OA, progression of osteoarthritis is the most common reason for reoperation and the proportion of reoperations due to loosening is higher than for TKR/OA, while the rate of infection is lower.

Figure 6.2.5 shows the distribution of the main interventions; replacement/insertion, extraction and other interventions not affecting the implant over three-year periods between 2001 and 2020. Replacement/insertion of prosthetic components has been the predominant intervention. However, over the last three triennial periods, the proportion has decreased due to increased reporting of other procedures. The most commonly reported procedures where the prosthesis is not affected are infection treatment/examination and mobilisation under anaesthesia.

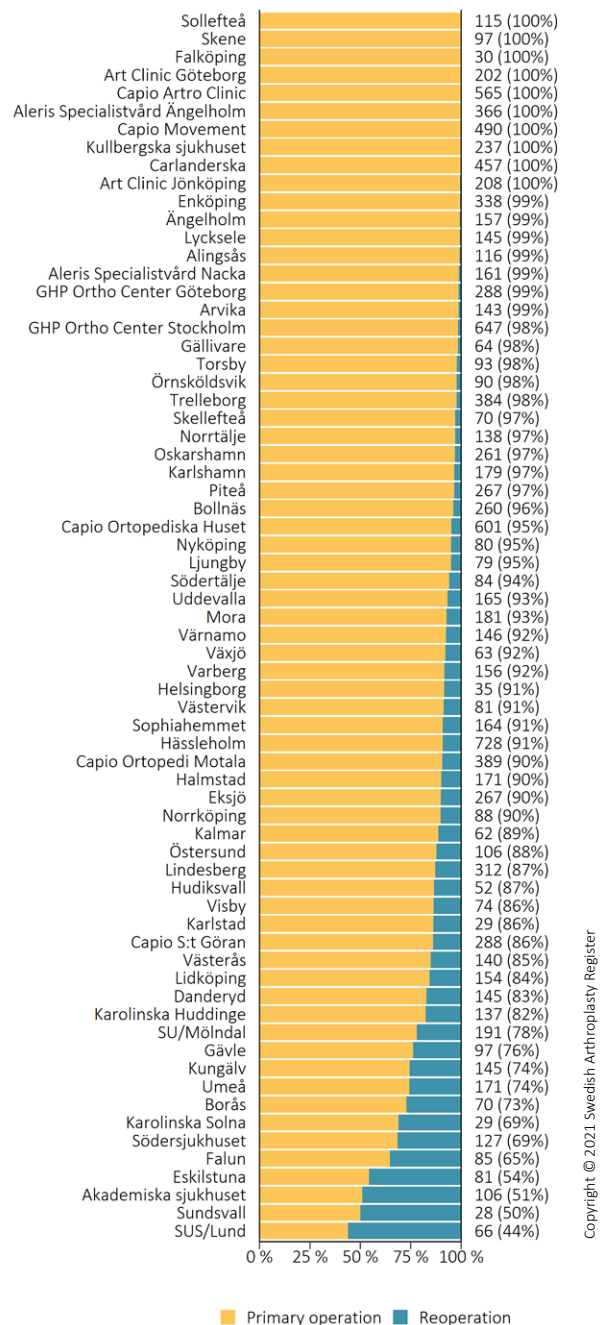


Figure 6.2.3. Distribution of primary and reoperations per unit 2020. Units with fewer than 20 operations are excluded.

Demography in reoperation

	Reoperation	Primary operation
Number	983	11,806
Age mean (SD)	69.17 (9.75)	68.54 (9.14)
Age group (%)		
< 45 years	6 (0.6)	55 (0.5)
45–54 years	66 (6.7)	754 (6.4)
55–64 years	239 (24.3)	3,116 (26.4)
65–74 years	349 (35.5)	4,529 (38.4)
75–84 years	281 (28.6)	3,037 (25.7)
≥ 85 years	42 (4.3)	315 (2.7)
Females (%)	507 (51.6)	6,492 (55.0)
BMI (%)		
< 18,5	2 (0.3)	20 (0.2)
18,5–24,9	123 (15.5)	2,227 (18.9)
25–29,9	336 (42.5)	5,151 (43.7)
30–34,5	237 (30.0)	3,393 (28.8)
35–40	77 (9.7)	873 (7.4)
>40	16 (2.0)	123 (1.0)
ASA class (%)		
ASA I	74 (9.3)	2,053 (17.4)
ASA II	462 (57.9)	7,822 (66.3)
ASA III-V	262 (32.8)	1,916 (16.2)
Diagnosis (%)		
Acute trauma	3 (0.3)	15 (0.1)
Osteoarthritis	912 (93.6)	11,451 (97.0)
Ideopathic necrosis	12 (1.2)	110 (0.9)
Inflammatory joint disease	31 (3.2)	154 (1.3)
Sequele fracture/trauma	12 (1.2)	62 (0.5)
Tumor	2 (0.2)	7 (0.1)
Other joint diseases	2 (0.2)	2 (0.0)

Table 6.2.1. Demography in reoperations (with diagnosis from previous primary operation). Primary operations performed in 2020 for comparison.

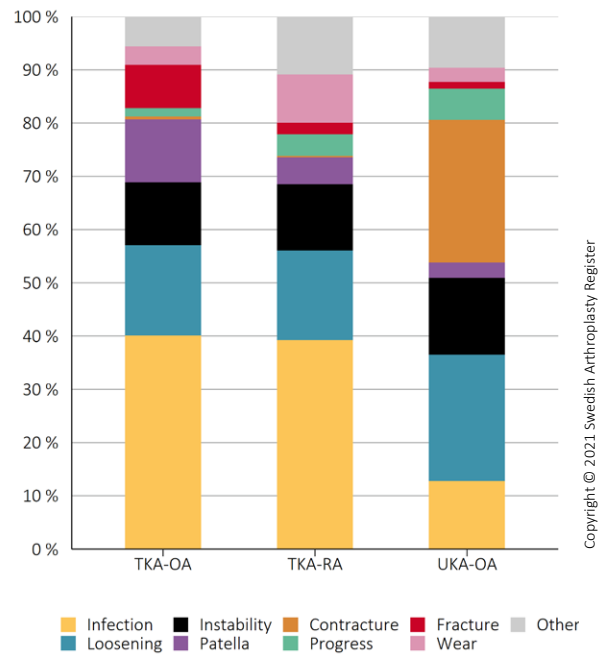


Figure 6.2.4. The most common reasons for reoperation in the last 10 years per operation/diagnosis.

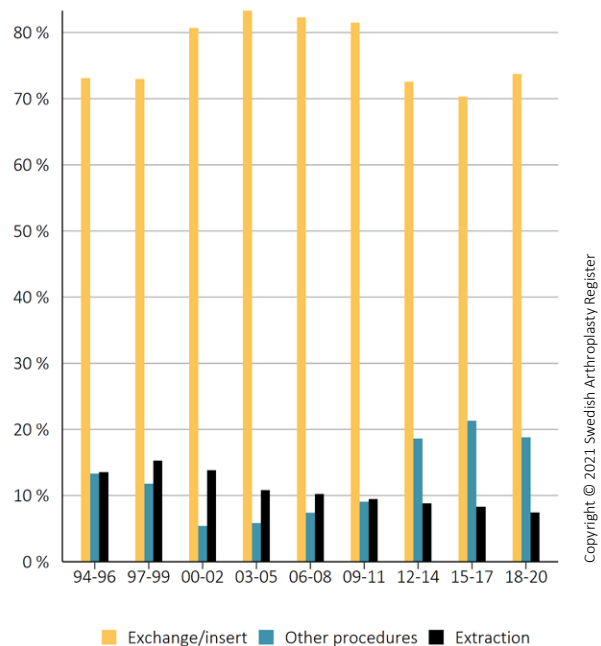


Figure 6.2.5. Distribution of the main procedures exchange/insertion, extraction and other procedures where the implant is not affected in three-year periods 2001–2020.

6.3 Reoperation within two years for TKR/OA

Authors: Annette W-Dahl and Martin Sundberg

Reoperations occurring in the first two years after a primary operation have been used as quality indicator in hip replacement surgery for several years and are selected by the Swedish Association of Local Authorities and Regions and the National Board of Health and Welfare as a national quality indicator and included in “Vården i siffror” (<https://vardenisiffror.se>). Reoperation within two years includes all forms of additional surgery after primary surgery. This outcome measure is intended to reflect mainly early and serious complications. The indicator is therefore considered important, readily available and easier to use for clinical improvement efforts, compared to the risk of revision at ten years. As previously described in chapter 6.2 we began systematically requesting other procedures than revisions from the units from 2013 for knee replacement surgery. The reason why two-year reoperations were not reported previously is partly because the reliability of reporting other procedures is uncertain, and partly because there are few reoperations per unit per year. Several years of reporting is therefore needed to obtain a reasonable number for a meaningful analysis at unit level. In addition, it is difficult to determine to what extent other procedures are reported and thus this may affect outcomes and disadvantage units that are good at reporting other procedures.

An indicator, in this case reoperation within 2 years, assumes that reporting is reliable, which we currently believe is not the case for knee replacement surgery.

Because of this, as a part of the harmonisation of the Swedish Arthroplasty Register, two-year reoperation after TKR for OA is presented in a slightly different form than for total hip replacements (see chapter 5.3 for hip) in this year's report. The aim is to show the situation for TKR in the number of reoperations within two years, and to encourage the reporting of interventions other than revisions in order to present a more reliable analysis in the future.

For TKR due to osteoarthritis, the two-year reoperations between 2017 and 2020 are presented for each unit respectively (university hospitals, private hospitals and others

in alphabetical order) and refers to events (number and proportion) within two years of the primary operation (table 6.3.1). Due to the reported low number of reoperations within two years, only infection (suspected or verified) is presented as a single group while other reasons for reoperation are combined into one group, “other reasons”. The number of revisions is provided to give an idea of the respective unit's reporting of other interventions than revision. The results of the aggregation are currently uncertain and do not give a fair picture of the proportion of reoperations within two years at national and unit level.

The most common reasons for reoperation within two years were infection, patella and loosening until 2010 with an increasing proportion for infection 2009–2010 (figure 6.3.1). This increase coincides in time with the adoption of a more surgically aggressive treatment for suspected early infections. After 2013 infection remains the most common reason for reoperation within two years but the proportion of joint stiffness and fracture as reasons has increased, probably due to changes in reporting practices.

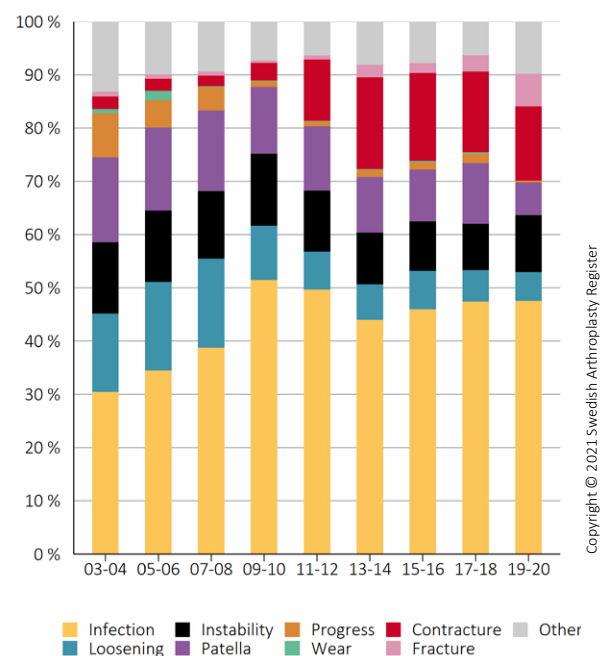


Figure 6.3.1. Distribution of reason for reoperation within two years after the primary operation in TKR/OA.

Number and proportion of reoperations within two years
after the primary operation per unit 2017–2020

Unit	Number primary	Number reoperation	Whereof revisions	Infection number	Infection %	Other reason number	Other reason %
University hospital							
Akademiska sjukhuset	261	16	7	7	2.68	9	3.45
Karolinska Huddinge	394	4	4	1	0.25	3	0.76
Karolinska Solna	98	1	1	1	1.02	0	0.00
SU/Möndal	1,191	13	12	10	0.84	3	0.25
SUS/Lund	85	2	2	1	1.18	1	1.18
Umeå	455	12	11	6	1.32	6	1.32
Private hospital							
Aleris Specialistvård Nacka	705	5	6	2	0.28	3	0.43
Aleris Specialistvård Ängelholm	442	3	3	1	0.23	2	0.45
Art Clinic Göteborg	532	3	2	3	0.56	0	0.00
Art Clinic Jönköping	647	2	2	1	0.15	1	0.15
Capio Artro Clinic	1,470	8	6	5	0.34	3	0.20
Capio Movement	1,731	14	9	7	0.40	7	0.40
Capio Ortopedi Motala	1,438	24	24	8	0.56	16	1.11
Capio Ortopediska Huset	2,519	104	31	8	0.32	96	3.18
Capio S:t Göran	1,298	14	12	5	0.39	9	0.69
Carlanderska	1,364	10	9	6	0.44	4	0.29
GHP Ortho Center Göteborg	836	9	9	3	0.36	6	0.72
GHP Ortho Center Stockholm	2,061	41	22	13	0.63	28	1.36
Hermelinen	69	0		0	0.00	0	0.00
Sophiahemmet	454	8	7	2	0.44	6	1.32
Other hospital							
Alingsås	700	14	2	7	1.00	7	1.00
Arvika	784	16	13	8	1.02	8	1.02
Bollnäs	1,113	11	9	5	0.45	6	0.54
Borås	317	4	2	1	0.32	3	0.95
Danderyd	330	7	6	5	1.52	2	0.61
Eksjö	974	28	20	12	1.23	16	1.64
Enköping	1,486	54	19	12	0.81	42	2.83
Eskilstuna	237	13	7	1	0.42	12	5.06
Falköping	63	0		0	0.00	0	0.00
Falun	524	16	7	3	0.57	13	2.48
Gällivare	293	1	1	1	0.34	0	0.00
Gävle	309	6	5	5	1.62	1	0.32
Halmstad	563	2	2	1	0.18	1	0.18
Helsingborg	83	3	3	1	1.20	2	2.41
Hudiksvall	210	3	3	2	0.95	1	0.48
Hässleholm	3,090	73	65	27	0.87	46	1.49

Number and proportion of reoperations within two years after the primary operation per unit 2017–2020, cont.

Unit	Number primary	Number reoperation	Whereof revisions	Infection number	Infection %	Other reason number	Other reason %
Kalmar	325	2	1	2	0.62	0	0.00
Karlshamn	905	6	5	1	0.11	5	0.55
Karlskoga	35	2	1	0	0.00	2	5.71
Karlstad	390	5	5	4	1.03	1	0.26
Kullbergska sjukhuset	746	26	20	9	1.21	17	2.28
Kungälv	579	38	13	24	4.15	14	2.42
Lidköping	733	13	10	3	0.41	10	1.36
Lindesberg	1,513	25	18	13	0.86	12	0.79
Ljungby	345	2	2	1	0.29	1	0.29
Lycksele	429	9	9	5	1.17	4	0.93
Mora	705	23	5	5	0.71	18	2.55
Norrköping	502	10	10	4	0.80	6	1.20
Norrtälje	603	9	8	4	0.66	5	0.83
Nyköping	291	4	4	0	0.00	4	1.37
Oskarshamn	1,357	40	19	9	0.66	31	2.28
Piteå	998	14	11	9	0.90	5	0.50
Skellefteå	343	9	7	6	1.75	3	0.87
Skene	469	6	5	3	0.64	3	0.64
Skövde	116	7	7	5	4.31	2	1.72
Sollefteå	677	15	15	8	1.18	7	1.03
Sundsvall	78	5	4	4	5.13	1	1.28
Södersjukhuset	731	13	8	9	1.23	4	0.55
Södertälje	512	3	1	2	0.39	1	0.20
Torsby	395	7	6	6	1.52	1	0.25
Trelleborg	2,662	41	40	26	0.98	15	0.56
Uddevalla	841	5	5	3	0.36	2	0.24
Varberg	584	9	7	7	1.20	2	0.34
Visby	374	8	6	2	0.53	6	1.60
Värnamo	707	8	7	4	0.57	4	0.57
Västervik	350	13	13	7	2.00	6	1.71
Västerås	864	19	18	11	1.27	8	0.93
Växjö	262	7	6	3	1.15	4	1.53
Ängelholm	874	9	9	4	0.46	5	0.57
Örnsköldsvik	441	10	4	3	0.68	7	1.59
Östersund	567	13	13	10	1.76	3	0.53
Country	51,460	979	665	397	0.77	582	1.13

Table 6.3.1. Number and proportion of reoperations (suspected or verified infection or other reason) within two years after primary operation 2017–2020 per unit. The number of primary and reoperations are given for comparison. Units with fewer than 20 operations in the current period are excluded but are included in the national figures. It should be noted that it is difficult to determine to what extent other procedures than revision is reported and thus it can affect the outcome and disadvantage units that are good reporting other procedures.

6.4 Revision regardless of primary diagnosis, reason for revision and intervention

Authors: Martin Sundberg and Annette W-Dahl

Revision is defined as only those reoperations of a knee replacement which means that components are inserted (added), exchanged or removed (including arthrodesis and amputation). This means that soft tissue procedures such as arthroscopy and lateral release are not registered as revisions.

The current status per surgical year for knee replacements is illustrated in figure 6.1.4 (a person can be included with both right and left knee). As shown in figure 6.4.1 almost 80% of the patients operated in 1980 have died without revision. One fifth of those operated at that time have undergone revision and of the few still alive more than half have been revised.

Demographics

There was a marginal difference in mean age at revision of TKR/OA 2020 compared to primary TKR 2020 (table 6.4.1). The mean age at revision of UKR/OA was just

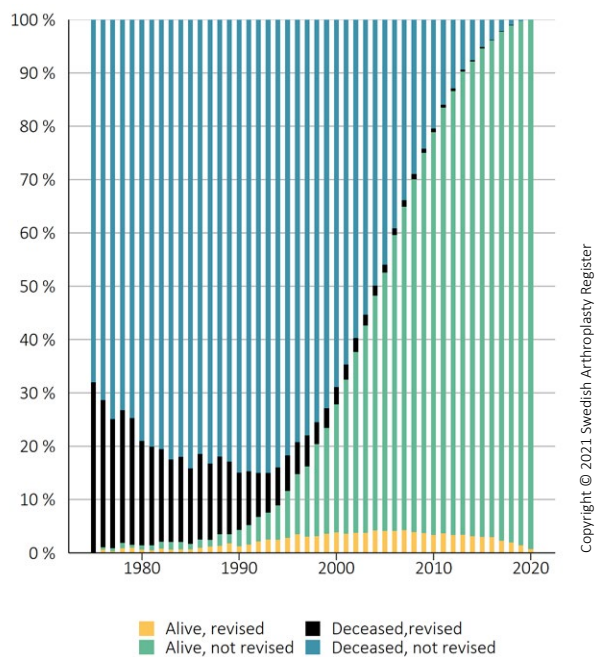


Figure 6.4.1. Current status per surgical year in patients having knee replacements.

over three years higher compared to primary UKR. While a slightly lower proportion of females with primary TKR were revised in relation to the proportion of females operated on with primary TKR, a higher proportion of females with primary UKR were revised than the proportion operated on with primary UKR. At revision for both TKR and UKR the proportion of obese (BMI ≥ 30) and classified as ASA $\geq III$ was higher than at primary surgery.

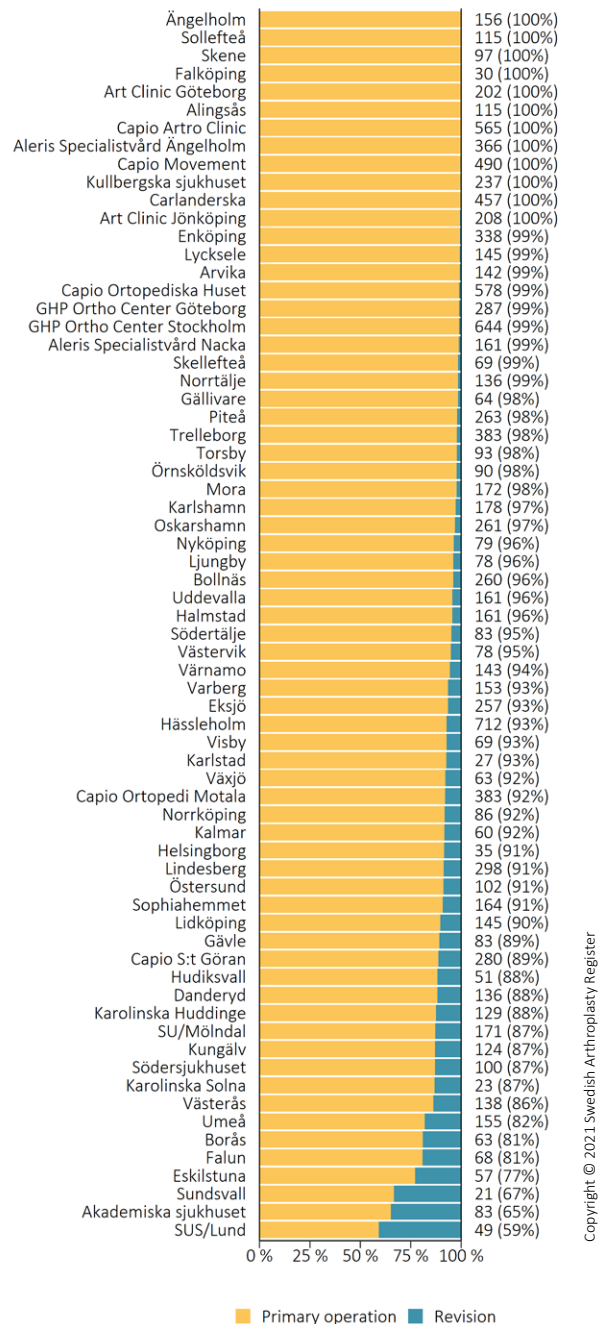


Figure 6.4.2. Revisions per unit 2020.

Demography in revisions 2020

	TKR-OA	TKR-RA	UKR-OA	Primary operation
Number	429	20	124	11,806
Age mean (SD)	69.4 (9.7)	69.7 (10.1)	68.7 (9.8)	68.5 (9.1)
Age group (%)				
<45 years	2 (0.5)	0 (0.0)	0 (0.0)	55 (0.5)
45–54 years	26 (6.1)	1 (5.0)	12 (9.7)	754 (6.4)
55–64 years	109 (25.4)	5 (25.0)	30 (24.2)	3,116 (26.4)
65–74 years	151 (35.2)	8 (40.0)	47 (37.9)	4,529 (38.4)
75–84 years	118 (27.5)	4 (20.0)	31 (25.0)	3,037 (25.7)
≥ 85 years	23 (5.4)	2 (10.0)	4 (3.2)	315 (2.7)
Females (%)	230 (53.6)	17 (85.0)	66 (53.2)	6,492 (55.0)
BMI (%)				
< 18,5	1 (0.2)	0 (0.0)	0 (0.0)	20 (0.2)
18,5–24,9	60 (14.4)	5 (26.3)	16 (13.3)	2,227 (18.9)
25–29,9	173 (41.6)	10 (52.6)	53 (44.2)	5,151 (43.7)
30–34,5	130 (31.2)	3 (15.8)	36 (30.0)	3,393 (28.8)
35–39,9	44 (10.6)	1 (5.3)	13 (10.8)	873 (7.4)
≥ 40	8 (1.9)	0 (0.0)	2 (1.7)	123 (1.0)
ASA class (%)				
ASA I	45 (10.7)	1 (5.3)	14 (11.6)	2,053 (17.4)
ASA II	246 (58.3)	7 (36.8)	77 (63.6)	7,822 (66.3)
ASA III–V	131 (31.0)	11 (57.9)	30 (24.8)	1,916 (16.2)

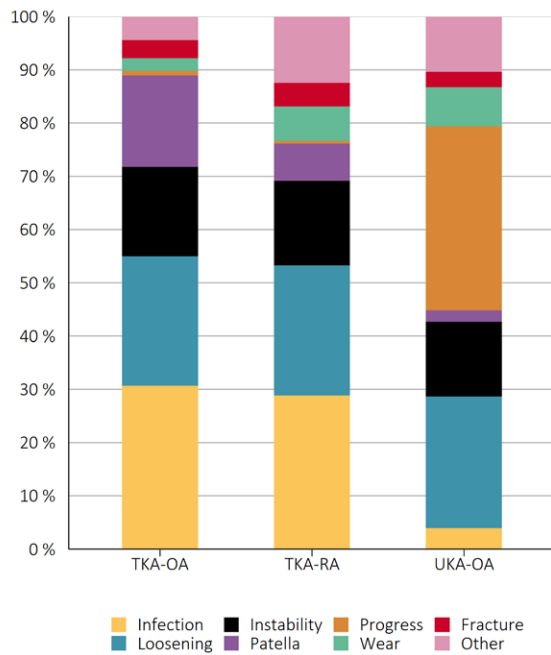
Table 6.4.1. Demography in revisions 2020 divided in TKR and UKR with primary operation for comparison.

Figure 6.4.2 shows the distribution of primary surgeries and revisions reported per unit in 2020. The number and proportion of primary operations are shown in the column on the right. Units with fewer than 20 operations have been excluded. The proportion of revisions per unit varies from SUS/Lund where about 40% of the operations are reported as revisions to units that have reported no revisions at all. The variation may be due, for example, to primary operations being performed in one or more units in a region while revisions are concentrated in another unit in the region.

Reason for revision

The most common reason for revision over the last ten years for TKR/OA, TKR/RA and UKR/OA are shown in

figure 6.4.3. For TKR/OA infection is now the most common reason for revision compared to previous reports when loosening dominated as reason. The reason of revision “progress” in TKR refers mainly to femoropatellar osteoarthritis. The reason of revision “patella” includes all kinds of patellar problems in replacements both with and without patellar component (but not loosening or wear of the patellar component). Note that the distribution of reasons for revision does not necessarily reflect the risk of having one of these complications. Since the number of primary operations for TKR/OA has increased substantially over time, early revisions are over-represented and so are infections. For UKR/OA progression of osteoarthritis is the most common reason for revision while the proportion of loosening is higher and the infection rate is lower than for TKR/OA.



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Figure 6.4.3. Distribution of reason for revision 2011–2020.

Revision procedures

The tables 6.4.2 a-c show the different types of first-time revisions carried out in 2011–2020, broken down by type of primary operation (TKR/OA, TKR/RA, UKR/OA). It should be noted that the type of revision is exclusive (only one type allowed for each revision) which means that, for example, in the case of patella surgery with simultaneous polyethylene/meniscus replacement, only the patella surgery is presented.

For TKR/OA and TKR/RA we see that revision involving polyethylene/meniscus replacement have continued to increase compared to previous periods, which is explained by the more aggressive treatment of early infections. Revisions with stabilized prosthesis are twice as common in RA as in OA. For UKR it is encouraging that no one is revised with a new UKR as this type of revision has been shown to have a high re-revision rate.

Factors affecting the revision rate

Implants

In order to report results for relatively modern types of prosthesis, but with reasonably long follow-up time, the most recent ten-year period available for analysis has been

chosen. A model is reported even after it has ceased to be used as long as there are reasonable numbers available for analysis. Note that the individual prosthesis model may represent different prosthesis variants, depending on modularity and marketing, among other factors, but within each model a few combinations tend to dominate.

In this year's report models reported in 25 or more operations 2011–2020 have been included. So also, revision models used in primary surgery. Triathlon MBT is reported divided into cemented and uncemented versions as Triathlon is the most reported cementless prosthesis in Sweden. Hazard ratio (HR) is adjusted for sex, age and year of surgery (table 6.4.3).

As before, the PFC-Sigma MBT is used as a reference for TKR because it is a relatively well-defined prosthesis, that is most of it consists of the same type of femur, tibial tray and plastic insert.

Legion/Genesis II MBT, Journey and Triathlon MBT uncemented have significantly higher HR than the reference PFC-MBT. Journey and Legion/Genesis II MBT were introduced in 2008 and 2013 respectively in Sweden and are still in use.

At the other end, Genesis II MBT, NexGen APT, NexGen MBT, NexGen TM, PFC-Sigma APT, Triathlon MBT cemented and Vanguard I-Beam have lower HR than the reference. Duracon has disappeared from the list.

We have chosen this year to also include revision models if they have been used to a sufficient extent. We are aware that these are used on primaries with more advanced osteoarthritis/malalignment and on patients with more severe conditions, but we still think it is of interest to show how these groups are performing. Of the revision models, the Triathlon Total Stabilizer shows a higher HR than the reference while the others show no significant difference.

Two different variants of the Vanguard prosthesis are presented, one using a tibial tray with a beamed stem I-Beam while the other uses a tibial tray with a winged stem (finned). The latter started to be used in 2010. In the 2018 report, the finned version had a significantly higher risk than the reference model PFC-MBT, but last year as well as this year the difference is not significant. In contrast, the Vanguard I-Beam shows significantly lower HR in this year's report. As Vanguard is no longer used in Sweden this is mostly of historical interest.

Procedure in revision of primary TKR/OA

Procedure	Number	Proportion (%)
Exchange of disc./insert	1,441	29.5
TKR without patella	1,156	23.6
Patella addition	878	18.0
Linked (rot. Hinge) without patella	418	8.6
TKR with patella	261	5.3
Exchange tibia	240	4.9
Extraction (two-staged)	198	4.1
Extraction	107	2.2
Exchange femur	54	1.1
Linked (rot. Hinge) with patella	48	1.0
Femoral amputation	33	0.7
Exchange patella	16	0.3
Arthrodesis	11	0.2
Extraction + prosthesis spacer (2016)	10	0.2
Patella extraction	8	0.2
Reposition of the same insert (2016)	5	0.1
Exchange of hinge part	3	0.1
Hinged without patella	1	0.0
Addition of screw/hinge part	1	0.0
Total	4,889	100

Table 6.4.2a. Reason for revision in primary TKR/OA 2011–2020.

Females have significantly lower 10-year HR for revision (all types) than males, which is mainly explained by males having higher risk of infection, which is most common early postoperatively. As in previous years, the risk decreases with increasing age. For this year, the risk is lower with increasing surgical year, which may be due to the fact that the number of revisions where the plastic insert is replaced in connection with treatment of an established or suspected infection does not increase with the same rate as before.

As in previous years Link is the reference for UKR (table 6.4.4). In the case of UKR inserted for OA, there are two models, Oxford and Link, that account for 78% of the operations. None of the UKR-models except Persona PK have a significantly different HR compared to the reference prosthesis Link. The risk of revision is decreasing with increasing age and increasing year of surgery.

Procedure in revision of primary TKR/RA

Procedure	Number	Proportion (%)
Exchange of disc./insert	55	27.4
TKR without patella	49	24.4
Linked (rot. Hinge) without patella	36	17.9
Patella addition	16	8.0
TKR with patella	10	5.0
Extraction (two-staged)	8	4.0
Extraction	7	3.5
Femoral amputation	7	3.5
Exchange femur	4	2.0
Linked (rot. Hinge) with patella	3	1.5
Exchange tibia	3	1.5
Extraction + prosthesis spacer (2016)	2	1.0
Arthrodesis	1	0.5
Total	201	100

Table 6.4.2b. Reason for revision in primary TKR/RA 2011–2020.

Procedure in revision of primary UKR/OA

Procedure	Number	Proportion (%)
TKR without patella	1,216	82.1
Exchange of disc./insert	120	8.1
TKR with patella	80	5.4
Linked (rot. Hinge) without patella	29	2.0
Extraction (two-staged)	11	0.7
Exchange tibia	9	0.6
Extraction	4	0.3
UKR medial	3	0.2
Exchange femur	2	0.1
Patellofemoral prosthesis	2	0.1
Patella addition	2	0.1
Femoral amputation	2	0.1
Reposition of the same insert (2016)	1	0.1
Total	1,481	100

Table 6.4.2c. Reason for revision in primary UKR/OA 2011–2020.

Hazard ratio with 95% confidence interval in revision TKR/OA

Implant	Number	p-value	HR
PFC Sigma TKR MBT	23,044		(ref.)
AGC Anatomica MBT	183	0.43	1.29 (0.69; 2.41)
Attune MB TKR	136	0.11	1.93 (0.86; 4.32)
Genesis II MBT	2,348	0.03	0.71 (0.51; 0.97)
Journey TKR	160	< 0.01	3.51 (2.14; 5.77)
Legion/Genesis II Pri MBT	1,803	< 0.01	1.60 (1.22; 2.10)
NexGen APT	866	< 0.01	0.32 (0.17; 0.58)
NexGen MBT	59,266	< 0.01	0.80 (0.72; 0.88)
NexGen Revision	393	0.92	0.97 (0.53; 1.76)
NexGen Trabecular Metal	2197	< 0.01	0.64 (0.48; 0.85)
Persona	1,219	0.11	1.40 (0.92; 2.14)
PFC Sigma TC-3 (revision)	237	0.12	1.67 (0.87; 3.23)
PFC Sigma TKR APT	8,497	< 0.01	0.63 (0.53; 0.75)
PFC Sigma TKR Rotating platform	160	0.55	1.22 (0.63; 2.36)
Profix	462	0.72	0.91 (0.56; 1.50)
Triathlon MBT Cemented	9,057	0.02	0.83 (0.71; 0.98)
Triathlon MBT Uncemented	5,442	< 0.01	1.40 (1.19; 1.63)
Triathlon Total Stabilizer	612	< 0.01	2.19 (1.53; 3.12)
Vanguard Finned Stem Modular	1,963	0.12	1.21 (0.95; 1.53)
Vanguard I-Beam Modular	5,094	< 0.01	0.75 (0.63; 0.90)
Other	577	0.02	1.58 (1.08; 2.30)
Sex = female		< 0.01	0.90 (0.84; 0.97)
Age		< 0.01	0.98 (0.97; 0.98)
Surgical year		< 0.01	0.97 (0.95; 0.98)

Table 6.4.3. Hazard ratio for revision with 95% confidence interval in UKR/OA 2011–2020.

Units with significantly better or worse results than the national average are shown in green and red respectively.

The risk of revision is only one of several measures of prosthetic models outcomes. The type of revision should also be considered, although it is not reported here. Consequently, a deliberate sparse use of the patella component, with a readiness to secondarily resurface if necessary, increases the revision rate. We therefore report TKR/OA separately for those with and without patellar component. The tables report models that occur both with and without patella. All other models (including revision models) are included as “others”.

We have divided TKR/OA in those used without a patella component (table 6.4.5) and those with a patella compo-

nent (table 6.4.6). This reduces the number of implants that can be analysed, especially for the group where a patella component has been used. We have also merged some groups compared to table 6.4.3 in order to analyse comparable groups. Compared to table 6.4.3 where all TKRs, with and without patella component are analysed, when no patella component is used, it is still the same models that have a significantly higher or lower HR than the reference PFC-Sigma MPT.

Where a patella component is used, the number of operated knees is small, and it becomes more difficult to show and even interpret significant differences. The Vanguard

Hazard ratio with 95% confidence interval in revision UKR/OA

Implant	Number	p-value	HR
Link	1,388		(ref.)
Oxford	5,806	0.5	1.09 (0.85; 1.40)
Persona-PK	102	0.03	2.58 (1.11; 5.97)
Sigma-PKR	248	0.35	0.71 (0.34; 1.46)
Triathlon Uni	555	0.23	1.29 (0.85; 1.95)
ZUK	984	0.61	0.92 (0.65; 1.29)
Other	144	0.55	1.19 (0.67; 2.10)
Sex = female		0.8	0.98 (0.82; 1.17)
Age		< 0.01	0.98 (0.97; 0.99)
Surgical year		< 0.01	0.92 (0.89; 0.96)

Table 6.4.4. Hazard ratio for revision with 95% confidence interval in TKR/OA 2011–2020. Units with significantly better or worse results than the national average are shown in green and red respectively.

I-Beam has a significantly better result than the reference regardless of whether or not a patella component is used. The effect of sex, age and increasing year of surgery is unchanged whether all TKRs are included or only those with or without a patella component.

As before we also present separate tables (6.4.7 and 6.4.8) where exchange of insert for infection has not been defined to be a revision. It has been argued that in the case of infection the register's definitions may disfavour different implant types. The reason is that almost half of all revisions for infection are synovectomies where the plas-

tic insert also is exchanged (which makes them count as revisions). In contrast, a synovectomy in a knee where the insert cannot be exchanged, is not regarded as a revision, which could favour that type, and therefore it has been argued that exchanging the plastic insert in case of infection should not be considered as a revision but as a soft tissue procedure. On the other hand, it could be argued that implants where the insert cannot be replaced should usually be treated with total revision (because a complete cleaning is not considered possible) which would lead to reversed bias if exchange of the insert was not considered as revision. Without being able to answer with certainty

Hazard ratio with 95% confidence interval in revision TKR/OA without patella component

Implant	Number	p-value	HR
PFC Sigma TKR MBT	22,200		(ref.)
Legion/Genesis II Pri MBT	1,677	< 0.01	1.55 (1.17; 2.06)
NexGen MBT	58,357	< 0.01	0.80 (0.72; 0.88)
PFC Sigma TKR APT	8,094	< 0.01	0.63 (0.53; 0.75)
Triathlon MBT	14,274	0.42	1.05 (0.93; 1.19)
Vanguard I-Beam Modular	4,792	0.02	0.81 (0.67; 0.97)
Other	11,235	0.98	1.00 (0.87; 1.14)
Sex = female		0.02	0.92 (0.85; 0.98)
Age		< 0.01	0.98 (0.97; 0.98)
Surgical year		< 0.01	0.97 (0.96; 0.99)

Table 6.4.5. Hazard ratio for revision with 95% confidence interval in TKR/OA without patella component 2011–2020. Units with significantly better or worse results than the national average are shown in green and red respectively.

Hazard ratio with 95% confidence interval in revision TKR/OA with patella component

Implant	Number	p-value	HR
PFC Sigma TKR MBT	844		(ref.)
Legion/Genesis II Pri MBT	126	0.2	1.90 (0.71; 5.03)
NexGen MBT	909	0.97	0.99 (0.57; 1.72)
PFC Sigma TKR APT	403	0.33	0.68 (0.31; 1.48)
Triathlon MBT	261	0.43	0.65 (0.23; 1.88)
Vanguard I-Beam Modular	302	< 0.01	0.14 (0.03; 0.60)
Other	331	0.98	1.01 (0.49; 2.08)
Sex = female		< 0.01	0.41 (0.26; 0.63)
Age		0.04	0.98 (0.95; 1.00)
Surgical year		0.27	0.95 (0.87; 1.04)

Table 6.4.6. Hazard ratio for revision with 95% confidence interval in TKR/OA with patella component 2011–2020. Units with significantly better or worse results than the national average are shown in green and red respectively.

what is the most reasonable course of action we have chosen here also to account for the risk when exchange of insert in case of infection is not considered as revision. It must be remembered that such an exclusion reduces the number of revisions, which in turn reduces the sensitivity of the statistical calculations.

For TKR/OA without consideration of patella resurfacing (table 6.4.7), compared to table 6.4.3, it can be seen that the same prostheses have increased HR compared to the reference, and Persona, which was neither worse nor better, is now worse than the reference. Exchange of plastic insert is not possible for NexGen APT, PFC-Sigma APT and the monobloc variant of NexGen TM and these therefore cannot benefit from insert exchange exclusion. Compared to the reference PFC MBT (with plastic insert that can be exchanged) all these also have slightly disadvantageous HR when plastic insert exchange is not considered a revision but are still better than the reference with the exception of PFC Sigma APT which is now neither worse nor better.

Females have before the exclusion of exchange of insert in case of infection a lower risk of revision than males but a higher risk after exclusion. This may indicate that their risk of revision is higher for reasons other than verified or suspected infection.

Persona PK that had a significantly higher HR when all revisions were included, but when the exchange of insert

in case of infection was excluded for UKR/OA, the HR was no longer significant (table 6.4.8).

In conclusion in this year's report, it does not seem to affect the overall result when exchange of insert in case of infection is not regarded as a true revision as it did in previous annual reports. The HR certainly decreases slightly for the all-modular models and for those with a non-modular tibial component HR increases slightly with this adjustment. One reason for this difference might be that a number of synovectomies without plastic insert exchange are successful in curing infections in the non-modular ones (if they had not been successful, the revision would probably have been reported), but unfortunately, we cannot account for this because synovectomies are reported inconsistently to the register. Another possible explanation is that surgeons are more liberal about opening and debriding knees when the plastic insert can be exchanged, which might have led to knees being revised that may not have needed it.

Underlying disease

Early on, it was realised that patients with different underlying diseases such as RA and OA could have different postoperative outcomes with different revision rates. Therefore, it has always been reported separate curves for these diagnoses. The modern medical treatment of RA has, however, decreased the need for knee replacements in this group and it has become increasingly difficult to see statistically significant differences.

Age

The effect of age at primary surgery can be illustrated by dividing the patients into different age groups where it is shown that in both TKR and UKR the risk of revision is higher in younger patients (figure 6.4.4). Possible explanations are that younger patients have a higher level of physical activity, greater demand for pain relief and/or that they have a health condition that more readily allow revision.

Year of operation

For TKR we saw a decrease in the risk of revision in the first three decades, which has not been as evident for UKR

(figure 6.4.5). For the period 2006–2015, the number of early revisions increased, a trend that has continued in the most recent period 2016–2020. This has been mainly due to an increase in the number of early revisions for infection (figure 6.4.6). For UKR the improvement over the first three decades was not nearly as marked as for TKR. But even for UKR the early revision rate increased in the period 2006–2015 and 2016–2020. However, the explanation here is mainly that since the late 1990s the relative proportion of younger patients receiving UKR has increased and they are at a higher risk.

Hazard ratio with 95 % confidence interval in revision TKR/OA.

Exchange of insert, in case of infection, is not considered to be revision.

Implant	Number	p-value	HR
PFC Sigma TKR MBT	23,044		(ref.)
AGC Anatomica MBT	183	0.1	1.70 (0.90; 3.18)
Attune MB TKR	136	0.6	1.35 (0.43; 4.22)
Genesis II MBT	2,348	< 0.01	0.53 (0.34; 0.82)
Journey TKR	160	< 0.01	4.45 (2.66; 7.44)
Legion/Genesis II Pri MBT	1,803	< 0.01	1.84 (1.35; 2.51)
NexGen APT	866	< 0.01	0.43 (0.23; 0.78)
NexGen MBT	59,266	< 0.01	0.81 (0.72; 0.90)
NexGen Revision	393	0.81	1.09 (0.56; 2.10)
NexGen Trabecular Metal	2,197	0.03	0.72 (0.53; 0.97)
Persona	1,219	0.05	1.66 (1.00; 2.75)
PFC Sigma TC-3 (revision)	237	0.13	1.78 (0.84; 3.76)
PFC Sigma TKR APT	8,497	0.06	0.84 (0.71; 1.01)
PFC Sigma TKR Rotating platform	160	0.79	1.11 (0.52; 2.34)
Profix	462	0.82	0.94 (0.53; 1.66)
Triathlon MBT Cemented	9,057	< 0.01	0.76 (0.63; 0.92)
Triathlon MBT Uncemented	5,442	< 0.01	1.48 (1.24; 1.78)
Triathlon Total Stabilizer	612	0.39	1.26 (0.74; 2.15)
Vanguard Finned Stem Modular	1,963	0.06	1.29 (0.99; 1.69)
Vanguard I-Beam Modular	5,094	0.04	0.81 (0.66; 0.99)
Other	577	0.05	1.56 (1.01; 2.41)
Sex = female		< 0.01	1.15 (1.05; 1.25)
Age		< 0.01	0.96 (0.96; 0.97)
Surgical year		< 0.01	0.97 (0.95; 0.99)

Table 6.4.7. Hazard ratio for revision with 95% confidence interval in TKR/OA 2011–2020. Exchange of insert due to infection has not been classified as revision. Units with significantly better or worse results than the national average are shown in green and red respectively.

Hazard ratio with 95 % confidence interval in revision UKR/OA.

Exchange of insert, in case of infection, is not considered to be revision.

Implant	Number	p-value	HR
Link	1,388		(ref.)
Oxford	5,806	0.66	1.06 (0.82; 1.36)
Persona-PK	102	0.09	2.19 (0.88; 5.47)
Sigma-PKR	248	0.36	0.71 (0.34; 1.47)
Triathlon Uni	555	0.21	1.31 (0.86; 1.98)
ZUK	984	0.55	0.90 (0.64; 1.27)
Other	144	0.56	1.18 (0.67; 2.09)
Sex = female		0.99	1.00 (0.83; 1.20)
Age		< 0.01	0.98 (0.97; 0.99)
Surgical year		< 0.01	0.92 (0.88; 0.95)

Table 6.4.8. Hazard ratio for revision with 95% confidence interval in UKR/OA 2011–2020. Link is the reference for UKA.

Cox regression adjusted for sex, age and surgical year. Exchange of insert due to infection has not been classified as revision.

When the Swedish Arthroplasty Register reports the risk of revision due to an infected knee replacement, this means the risk of being revised for infection at some point (first or any subsequent revision) (figure 6.4.6). This risk decreased in the first decades for both RA and OA. In the period 2006–2015, for TKR, we saw a significant increase in the risk of revision for infection compared to the past which continues in the years 2016–2020 and now also for UKR. The increase is mainly due to early plastic insert exchanges in forces of infections or suspected infections. The increase is probably due to the fact that treatment in recent years has been more focused on early surgical intervention for suspected infections

Sex

The effect of sex on revision risk is complex because the sexes have different revision patterns. Revision for early infection is over-represented in males while for females loosening and patella problems are the that predominate early. The difference between the sexes is even greater when the breaking point only includes revisions for infection (figure 6.4.7). It is well-known that RA patients have an increased propensity for infection which has been attributed to their underlying disease and immunosuppressive treatment. However, it is not as evident why males are more likely to be revised for infection than females.

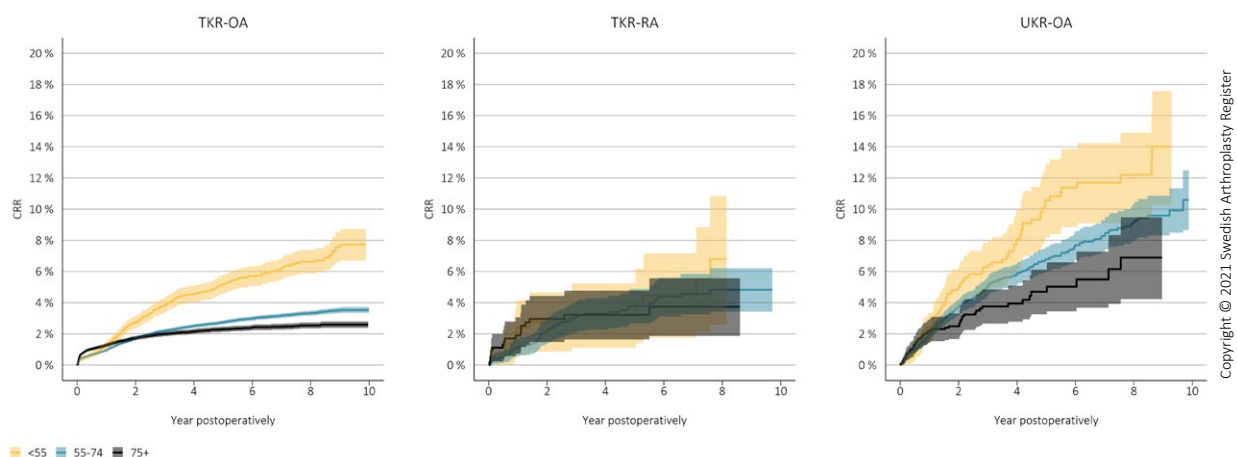


Figure 6.4.4. CRR in different age groups TKR/OA (left), TKR/RA (middle) and UKR/OA (right) inserted in the period 2011–2020.

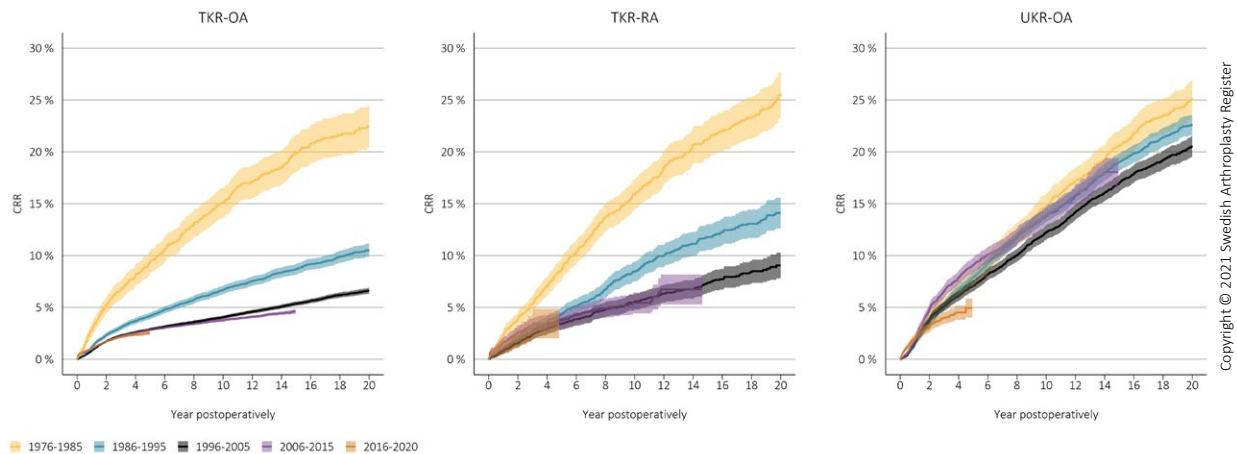


Figure 6.4.5. CRR in different periods up to 20 years in TKR/OA (left), TKR/RA (middle) and UKR/OA (right).

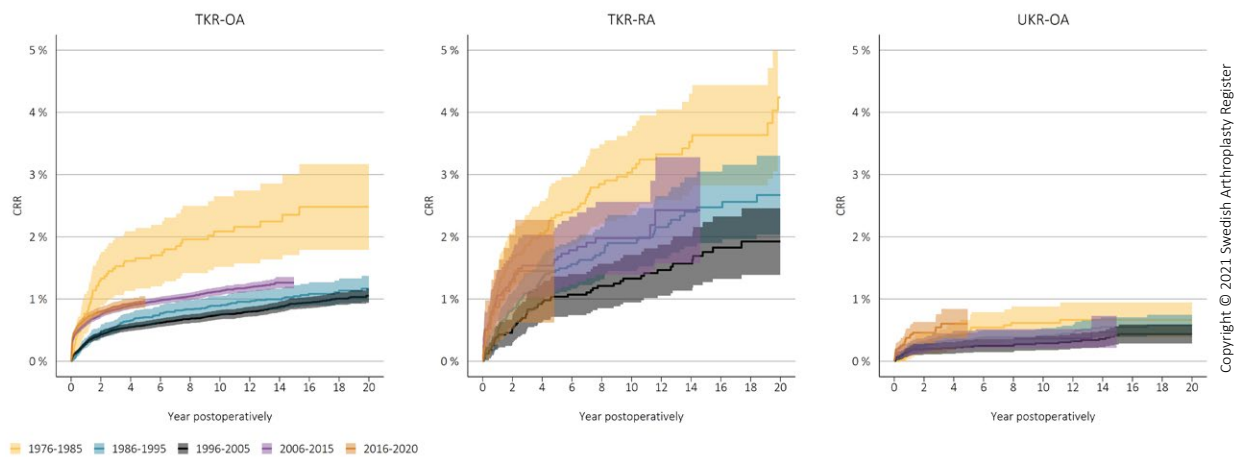


Figure 6.4.6. CRR due to infection in different periods up to 20 years in TKR/OA (left), TKR/RA (middle) and UKR/OA (right).

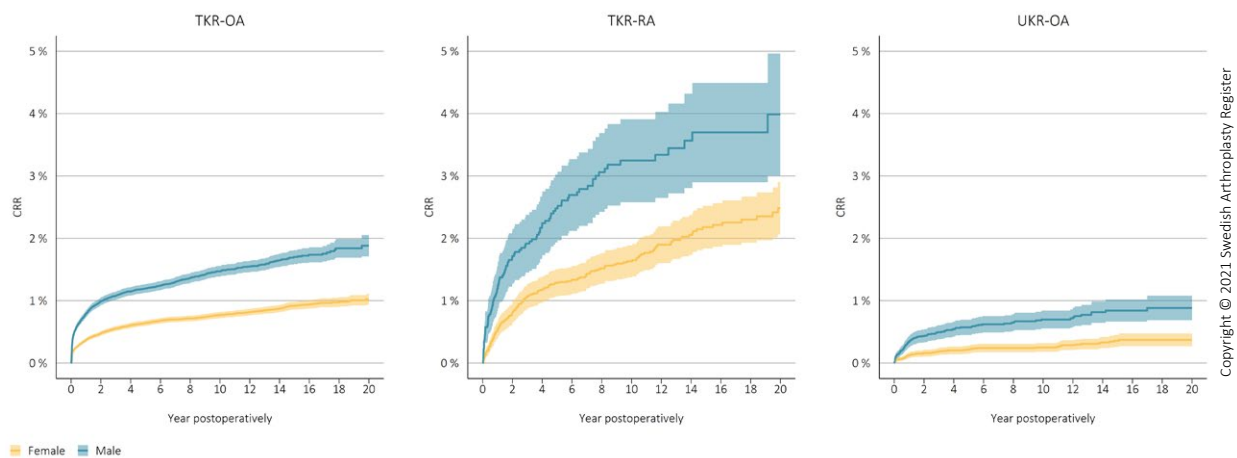


Figure 6.4.7. CRR due to infection by sex up to 20 years in TKR/OA (left), TKR/RA (middle) and UKR/OA (right).

Patella component in TKR

How the use of a patella component affects the risk of revision is complex. The use is different depending on the prosthesis model, while at the same time it has decreased over the years. In the 2002 annual report we noted for the first time that TKR with patella component (inserted 1991–2000) had a lower revision risk than those without. Figure 6.4.8 shows results for TKR with and without patella component inserted in the period 1991–2000. In this period, TKR without patella component had a significantly higher revision rate than those with patella component (HR 1.3 (CI 1.1–1.4)). An analysis of the period 2001–2010 (figure 6.4.9) shows, on the contrary, that TKR without patella component have a significantly lower revision rate (HR 0.8 (CI 0.7–0.9)). However, for the current period 2011–2020 the difference is not significant (HR 0.9 (CI 0.8–1.2)).

We can only speculate on the reasons for this. The insertion of the patella component takes extra time during surgery and involves an extra prosthetic part to be fixed to the bone and which can wear down, so there is an increased risk of infection, prosthesis loosening and wear. Therefore, modifications in the quality and fixation of the patella components may be the reason for the changes in the risk of revision over time. On the other hand, a pro-

portion of the TKRs without a primary patella component are secondarily operated with such a component. The fact that femoral components have become more “patella friendly” and/or the surgeons’ enthusiasm for secondary patella resurfacing has changed, are also possible explanations for these inconsistent outcomes.

It is arguable whether the use of patella component should be taken into account when assessing revision risk for units and implants respectively. We have chosen to present the implants’ total risk of revision (with and without patella component). This gives a comprehensive view of the situation for certain patient groups and implants. When comparing HR for implants (tables 6.4.5–6.4.6) we present the results separately for TKR with and without patella component and when we assess the revision risk for the different units, we take into consideration in the regression analysis whether a patella component has been used or not.

Use of cement

Cement has been used in a large majority of the operations since the mid-1990s, although with an increase in cementless cases in recent years. We have previously shown in an analysis for TKRs inserted in the period 1985–1994, when the use of cementless implants was slightly more common, that these had higher risk of revision. Also, in

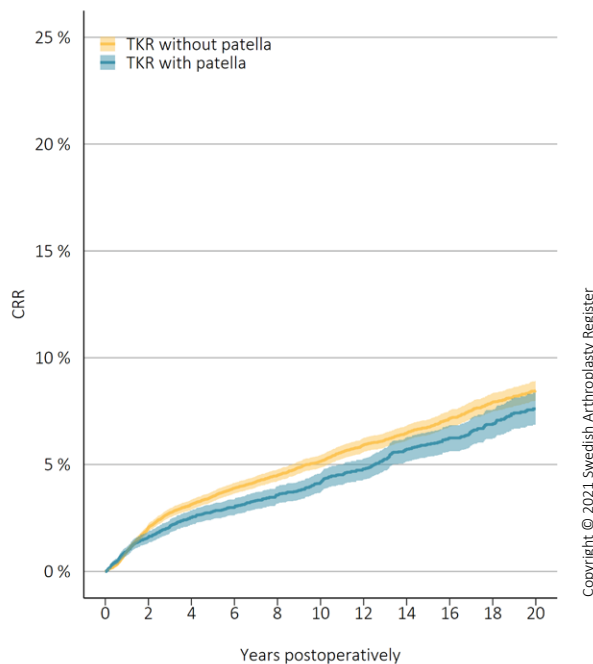


Figure 6.4.8. CRR in TKR/OA inserted in the ten-year period 1991–2000, with or without patella component respectively.

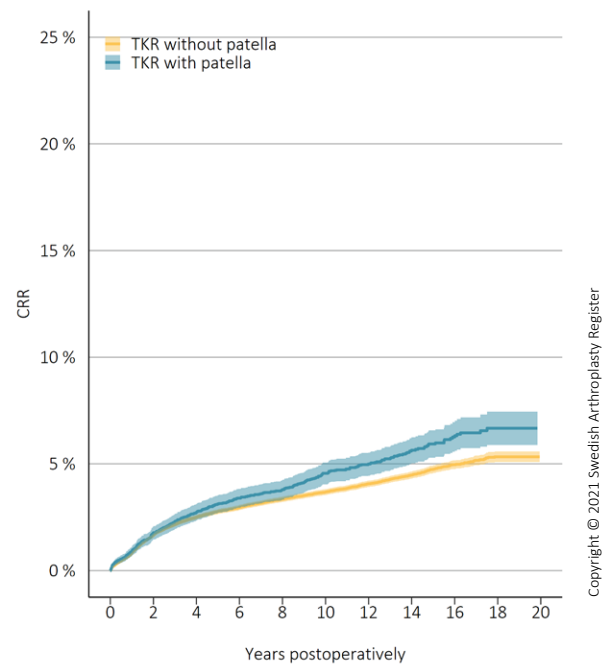


Figure 6.4.9. CRR in TKR/OA inserted in the ten-year period 2001–2010, with or without patella component respectively.

the last ten-year period we see a significantly higher risk of revision for cementless implants compared to cemented ones (figure 6.4.10).

Risk of revision per unit

What is the true average outcome of a given treatment at a given unit can only be determined for defined groups of already treated subjects. Such results, however, only reflect historical conditions and cannot easily be used for comparisons of future treatment outcomes. The observed average result of a treatment at a unit is not constant. Different samples of patients receiving the same treatment have different average outcomes. This hospital-specific variability must be taken into account in order to make comparisons between units meaningful.

In this year's report from the Swedish Arthroplasty Register harmonisation has been made in selections, methods and presentation of the results to be equivalent for knee and hip replacement surgery, but it is not yet fully consistent. Traditionally operations from a 10-year period (for example 2010–2019) have been included when calculating the cumulative revision rate (CRR) and with a one-year delay. In the analyses that follow, an additional year has been included, so also the most recent year, so the period becomes 2010–2020. This change means that operations

can be followed for more than 10 years instead of more than 9 years. Including the most recent year's revisions may result in missing revisions, as we know from experience that revisions will be reported in the coming year.

Table 6.4.9 shows for each unit the number of primary surgeries (TKR) performed for OA over the 6-year period analysed (2015–2020) and how many of these have been revised. Table 6.4.10 shows the corresponding numbers but for an 11-year period (2010–2020). This is followed by the RR (relative revision risk) with 95% confidence intervals. This estimates unit effects on revision risk relative to the national average and has been calculated as in previous years using the “shared gamma frailty model”. Finally, the observed rank of the unit is shown together with a 95% confidence interval for the rank. The calculation has been performed using the Monte Carlo method.

In contrast to previous years, the unit decides where the operation is registered and not the location (hospital), as part of the harmonisation of the knee and hip replacement registers. The names of the units have also been harmonised. This does not represent a considerable difference from the past, as the knee arthroplasty register has registered both the location and unit of the operations for the last ten years.

Only units where more than 50 primary operations have been performed in the period are included in the analysis (TKR performed for OA). The results have been adjusted for differences in sex and age distribution as well as for differences in the distribution of prostheses with and without patella component. The units that are significantly better or worse than the national average are marked in green and red respectively.

Figures 6.4.11 and 6.4.12 show CRR after five and ten years respectively (primary operations 2015–2020 and 2010–2020 included). Units with fewer than 50 primary operations in the last five and ten years respectively are not presented, but are included in the national data.

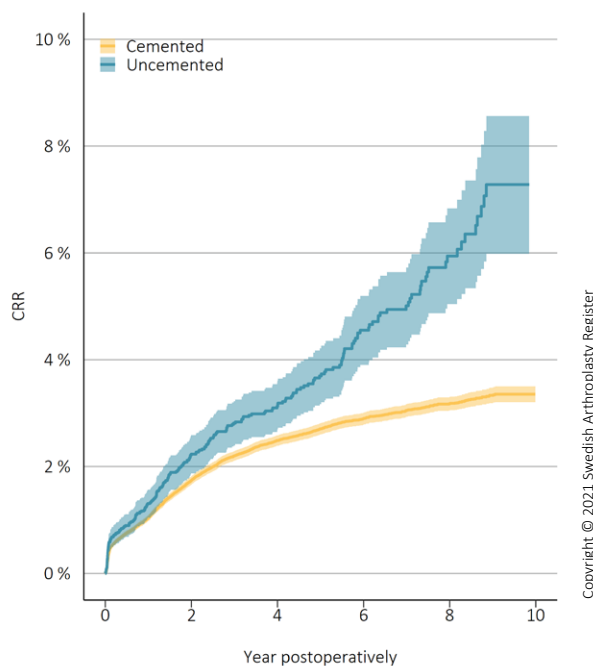


Figure 6.4.10. CRR in TKR/OA inserted in the ten-year period 2011–2020, with or without patella component respectively.

Relative risk of revision per unit, five years

Unit	Number TKA	Revised	RR	RR 95% CI	Rang	Rang 95% CI
Alingsås	1,050	8	0.56	0.35; 0.90	1	1; 31
Art Clinic Jönköping	694	2	0.56	0.31; 1.02	2	1; 42
Capio Arthro Clinic	1,470	8	0.56	0.35; 0.91	3	1; 31
Aleris Specialistvård Nacka	1,002	8	0.58	0.36; 0.94	4	1; 34
Karlshamn	1,403	14	0.61	0.40; 0.92	5	1; 32
Halmstad	927	9	0.63	0.40; 1.01	6	1; 41
Karolinska Solna	231	1	0.68	0.37; 1.27	7	1; 59
GHP Ortho Center Göteborg	1,071	12	0.73	0.47; 1.12	8	2; 50
Värnamo	959	11	0.73	0.47; 1.14	9	2; 51
Carlanderska	1,647	19	0.74	0.51; 1.08	10	3; 47
Gällivare	390	3	0.75	0.42; 1.32	11	1; 61
Art Clinic Göteborg	600	5	0.75	0.44; 1.27	12	2; 59
Kalmar	488	5	0.75	0.44; 1.27	13	2; 59
Karlskoga	246	3	0.76	0.43; 1.34	14	1; 62
Uddevalla	1,196	15	0.77	0.51; 1.15	15	3; 52
GHP Ortho Center Stockholm	2,885	41	0.77	0.58; 1.02	16	5; 42
Capio Movement	2,527	39	0.81	0.61; 1.08	17	7; 47
Borås	454	6	0.84	0.51; 1.41	18	3; 65
Jönköping	272	5	0.85	0.50; 1.44	19	3; 65
Mora	1,085	17	0.85	0.58; 1.25	20	5; 58
Örnsköldsvik	684	11	0.85	0.55; 1.32	21	4; 62
Skene	669	10	0.86	0.55; 1.35	22	4; 63
Capio Ortopediska Huset	3,559	60	0.86	0.68; 1.09	23	10; 49
Karolinska Huddinge	639	10	0.87	0.56; 1.37	24	5; 64
Capio S:t Göran	2,069	37	0.88	0.65; 1.18	25	9; 54
Aleris Specialistvård Ängelholm	442	3	0.88	0.50; 1.56	26	3; 69
Piteå	1,451	24	0.89	0.63; 1.25	27	8; 58
Trelleborg	4,214	78	0.89	0.72; 1.11	28	13; 49
Varberg	844	14	0.9	0.59; 1.35	29	6; 63
Bollnäs	1,736	32	0.9	0.66; 1.23	30	9; 57
Nyköping	445	7	0.9	0.55; 1.47	31	5; 67
Västerås	1,226	21	0.91	0.63; 1.30	32	8; 61
Södertälje	781	14	0.93	0.62; 1.40	33	7; 65
Hermelinen	87	1	0.93	0.50; 1.74	34	3; 72
Ängelholm	1,364	26	0.94	0.67; 1.31	35	10; 61
Falköping	63		0.94	0.48; 1.81	36	3; 72
Södersjukhuset	1,246	25	0.94	0.67; 1.32	37	10; 61
Hudiksvall	367	7	0.95	0.58; 1.56	38	6; 69
Lindesberg	1,971	36	0.98	0.73; 1.32	39	14; 62

Relative risk of revision per unit, five years, cont.

Unit	Number TKA	Revised	RR	RR 95% CI	Rang	Rang 95% CI
Capio Ortopedi Motala	2,064	40	0.99	0.74; 1.31	40	15; 61
Oskarshamn	1,926	38	1.01	0.75; 1.35	41	16; 63
Ljungby	563	12	1.02	0.66; 1.56	42	10; 69
Visby	505	10	1.02	0.65; 1.61	43	9; 70
Torsby	615	13	1.04	0.68; 1.58	44	11; 69
Karlstad	716	17	1.05	0.71; 1.54	45	13; 69
Akademiska sjukhuset	435	11	1.07	0.69; 1.66	46	11; 71
Växjö	430	10	1.07	0.68; 1.68	47	11; 71
Falun	978	24	1.07	0.76; 1.51	48	16; 68
SU/Mölnadal	1,994	47	1.09	0.83; 1.42	49	23; 66
Danderyd	550	13	1.09	0.72; 1.66	50	13; 71
Enköping	2,198	47	1.09	0.84; 1.43	51	23; 66
Arvika	1,138	25	1.11	0.79; 1.55	52	19; 69
Frölunda Specialistsjukhus	124	5	1.11	0.65; 1.88	53	9; 73
Örebro	66	3	1.12	0.63; 1.98	54	8; 73
Gävle	531	14	1.15	0.76; 1.74	55	17; 72
Östersund	805	19	1.15	0.79; 1.67	56	20; 71
Sollefteå	865	20	1.17	0.81; 1.69	57	22; 71
Skellefteå	532	14	1.18	0.78; 1.77	58	19; 72
Norrälje	804	19	1.19	0.82; 1.72	59	22; 72
Sophiahemmet	601	18	1.22	0.83; 1.78	60	23; 72
Sundsvall	128	5	1.23	0.72; 2.08	61	14; 74
Helsingborg	189	7	1.23	0.75; 2.02	62	16; 74
Lycksele	593	16	1.24	0.83; 1.83	63	24; 73
Lidköping	1,185	33	1.26	0.93; 1.71	64	33; 71
SUS/Lund	177	7	1.26	0.77; 2.07	65	18; 74
Eksjö	1,355	34	1.27	0.94; 1.72	66	34; 72
Västervik	536	16	1.3	0.88; 1.93	67	28; 73
Umeå	676	21	1.32	0.92; 1.90	68	32; 73
Skövde	337	14	1.33	0.88; 2.00	69	28; 74
Norrköping	775	24	1.34	0.95; 1.88	70	35; 73
Hässleholm	4,459	142	1.57	1.33; 1.85	71	61; 73
Kullbergska sjukhuset	1,043	37	1.61	1.20; 2.16	72	55; 74
Kungälv	897	38	1.74	1.31; 2.33	73	61; 74
Eskilstuna	324	19	1.86	1.28; 2.70	74	60; 74

Table 6.4.9. Relative risk of revision per unit, five years.

Relative risk of revision per unit, ten years

Unit	Number TKA	Revised	RR	RR 95% CI	Rang	Rang 95% CI
Alingsås	2,035	19	0.41	0.28; 0.61	1	1; 10
Art Clinic Jönköping	716	2	0.43	0.21; 0.88	2	1; 30
Aleris Specialistvård Nacka	1,663	16	0.44	0.29; 0.67	3	1; 14
Capio Artro Clinic	1,471	8	0.48	0.28; 0.82	4	1; 24
Carlanderska	2,249	29	0.59	0.42; 0.83	5	2; 25
Karolinska Huddinge	1,238	17	0.59	0.39; 0.89	6	2; 32
Jönköping	1,018	17	0.61	0.40; 0.92	7	2; 34
Kalmar	917	12	0.62	0.39; 0.99	8	2; 42
Sabbatsberg	614	11	0.63	0.39; 1.01	9	2; 44
Karlshamn	2,557	40	0.64	0.47; 0.85	10	4; 28
GHP Ortho Center Göteborg	1,585	24	0.64	0.45; 0.93	11	3; 36
Karolinska Solna	689	12	0.65	0.41; 1.04	12	2; 46
Värnamo	1,587	25	0.67	0.47; 0.96	13	4; 39
Art Clinic Göteborg	600	5	0.68	0.37; 1.24	14	2; 59
Capio Movement	3,714	66	0.73	0.58; 0.92	15	8; 35
Spenshult	1,103	27	0.74	0.53; 1.05	16	6; 47
Hudiksvall	726	13	0.74	0.47; 1.17	17	4; 56
Gällivare	757	13	0.77	0.49; 1.22	18	5; 58
GHP Ortho Center Stockholm	4,933	100	0.79	0.65; 0.96	19	12; 39
Aleris Specialistvård Ängelholm	442	3	0.81	0.42; 1.59	20	3; 71
Örnsköldsvik	1,219	25	0.82	0.57; 1.17	21	8; 56
Falköping	242	5	0.83	0.45; 1.51	22	4; 69
Halmstad	1,93	43	0.83	0.63; 1.10	23	10; 52
Karlskoga	820	20	0.84	0.57; 1.24	24	8; 60
Piteå	2,716	57	0.84	0.66; 1.08	25	12; 50
Hermelinen	96	1	0.85	0.40; 1.83	26	2; 75
Växjö	941	21	0.85	0.58; 1.25	27	8; 60
Lindesberg	2,812	55	0.88	0.68; 1.13	28	14; 54
Borås	892	19	0.88	0.59; 1.31	29	9; 63
Nyköping	896	20	0.89	0.60; 1.31	30	9; 63
Trelleborg	7,5	174	0.9	0.77; 1.04	31	20; 47
Mora	1,910	43	0.91	0.68; 1.20	32	14; 58
Skene	1,178	27	0.91	0.64; 1.28	33	12; 62
Capio Ortopediska Huset	5,45	127	0.91	0.77; 1.09	34	20; 51
Uddevalla	2,095	45	0.92	0.70; 1.21	35	15; 58
Oskarshamn	3,101	70	0.92	0.73; 1.15	36	17; 55
Capio S:t Göran	3,740	89	0.92	0.75; 1.13	37	19; 54
Enköping	3,889	88	0.92	0.75; 1.13	38	18; 54
Capio Ortopedi Motala	4,131	99	0.93	0.76; 1.13	39	19; 53

Relative risk of revision per unit, ten years, cont.

Unit	Number TKA	Revised	RR	RR 95% CI	Rang	Rang 95% CI
Västerås	2,499	62	0.94	0.74; 1.20	40	18; 58
Torsby	1,158	28	0.96	0.68; 1.35	41	14; 64
Frölunda Specialistsjukhus	681	21	0.96	0.66; 1.41	42	12; 66
Varberg	1,609	40	0.96	0.72; 1.29	43	16; 62
Arvika	1,907	44	0.96	0.73; 1.28	44	17; 62
Ängelholm	2,206	55	0.99	0.77; 1.27	45	20; 62
Karlstad	1,585	43	0.99	0.75; 1.31	46	18; 63
Elisabethsjukhuset	213	8	1.01	0.59; 1.71	47	9; 73
Sundsvall	643	19	1.02	0.69; 1.52	48	15; 69
Södersjukhuset	2,574	76	1.06	0.85; 1.32	49	27; 63
Ljungby	1,112	31	1.06	0.77; 1.47	50	20; 68
SU/Möndal	3,187	87	1.08	0.88; 1.32	51	30; 64
Örebro	410	15	1.08	0.70; 1.67	52	15; 73
Danderyd	1,195	34	1.1	0.81; 1.51	53	23; 69
Östersund	1,502	42	1.12	0.84; 1.50	54	27; 69
Skellefteå	996	30	1.13	0.82; 1.58	55	24; 71
Sophiahemmet	919	31	1.14	0.83; 1.58	56	25; 71
Lidköping	1,969	57	1.15	0.89; 1.47	57	32; 68
Eksjö	2,155	58	1.16	0.90; 1.48	58	33; 68
Södertälje	1,295	39	1.16	0.87; 1.56	59	29; 70
Bollnäs	3,156	97	1.17	0.96; 1.42	60	38; 67
Norrköping	1,467	45	1.18	0.89; 1.55	61	32; 70
Akademiska sjukhuset	882	33	1.2	0.87; 1.65	62	30; 72
Falun	2,580	91	1.21	0.99; 1.49	63	42; 69
Skövde	983	38	1.3	0.96; 1.75	64	39; 74
Visby	923	34	1.37	1.00; 1.88	65	43; 75
Lycksele	938	33	1.4	1.02; 1.92	66	45; 76
SUS/Lund	343	14	1.41	0.91; 2.20	67	34; 77
Västervik	992	38	1.46	1.09; 1.97	68	50; 76
Norrtälje	1,161	40	1.47	1.10; 1.97	69	51; 76
Kullbergsska sjukhuset	2,151	88	1.52	1.24; 1.87	70	59; 75
Helsingborg	302	14	1.54	0.99; 2.40	71	42; 77
Gävle	1,043	45	1.55	1.18; 2.05	72	56; 76
Sollefteå	1,352	53	1.6	1.23; 2.07	73	59; 76
Hässleholm	7,615	309	1.6	1.43; 1.80	74	66; 75
Umeå	1,362	64	1.62	1.28; 2.06	75	61; 76
Eskilstuna	486	26	1.87	1.32; 2.65	76	63; 77
Kungälv	1,660	93	2.07	1.69; 2.52	77	73; 77

Table 6.4.10. Relative risk of revision per unit, ten years.

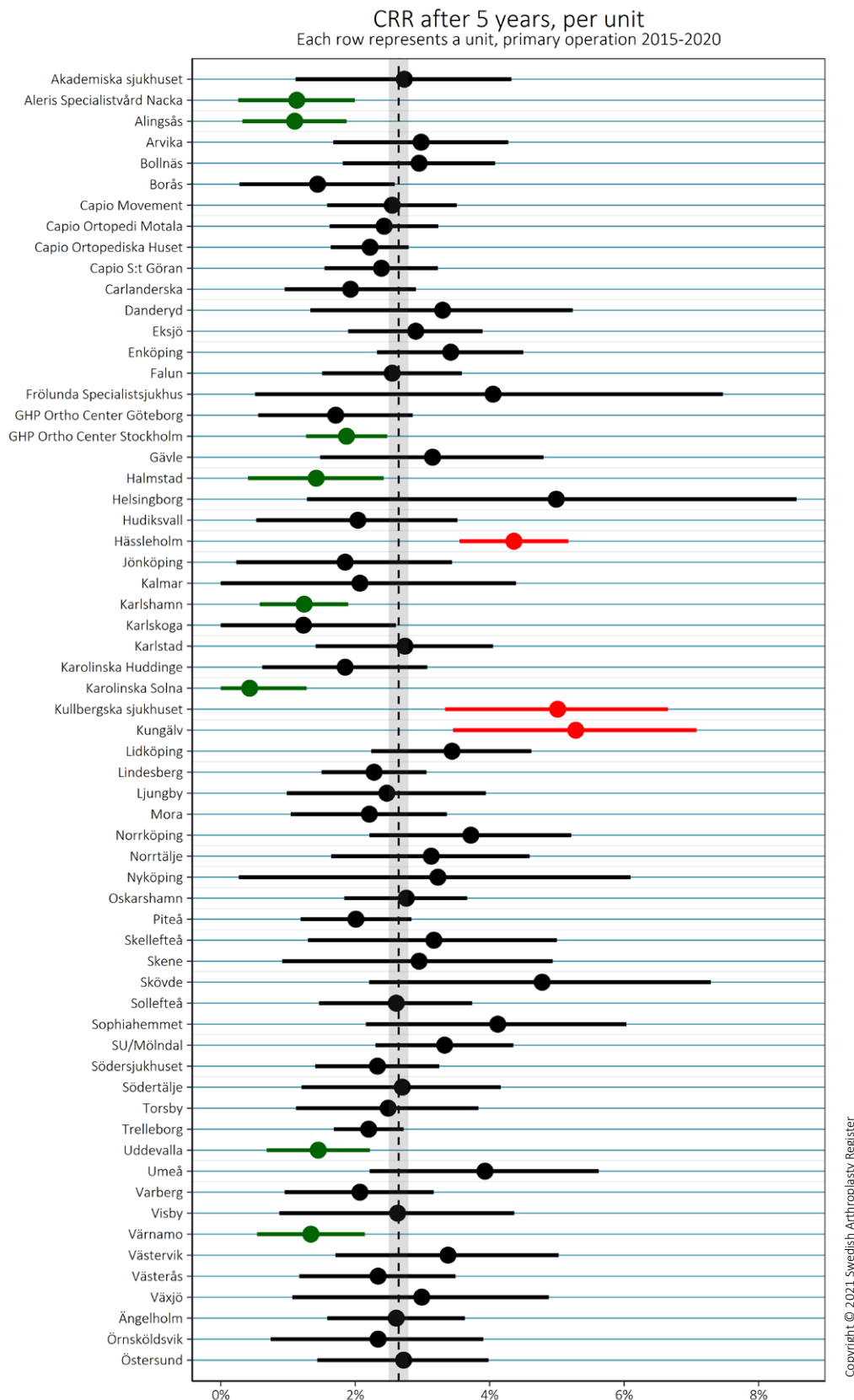


Figure 6.4.11. CRR after five years per unit (primary operation 2015–2020).
Units with fewer than 50 primary operations in the last five years are not presented.

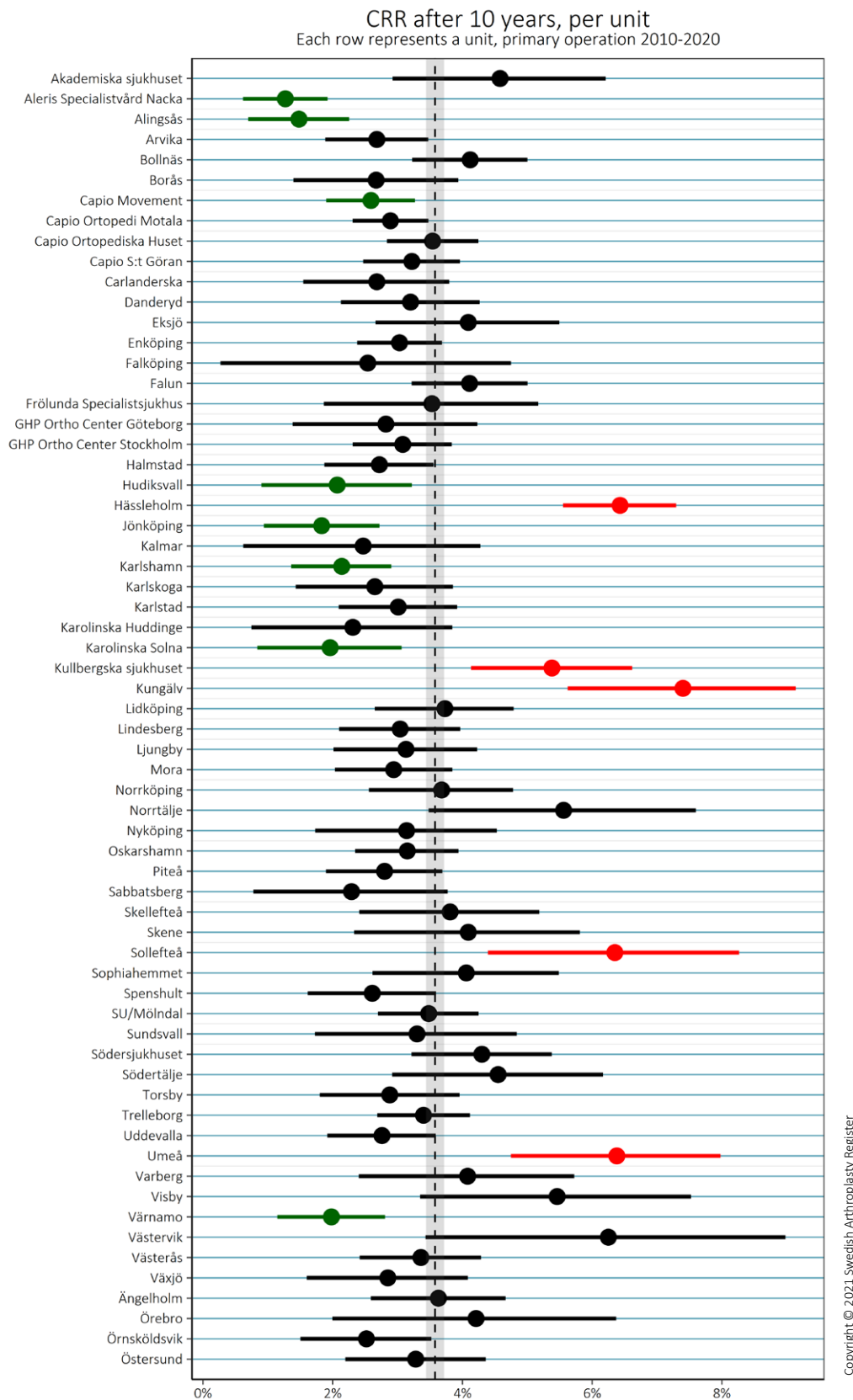


Figure 6.4.12. CRR after ten years per unit (primary operation 2010–2020).
Units with fewer than 50 primary operations in the last five years are not presented.

6.5 Knee osteotomy

Authors: Annette W-Dahl and Martin Sundberg

Joint saving surgery – knee osteotomy

High tibial osteotomy was introduced in Sweden in 1969 by professor Göran Bauer in Lund as a standard treatment for unicompartmental knee osteoarthritis. After the introduction of modern knee prostheses in the mid-1970s these instead became relatively quickly the most common surgical treatment for knee osteoarthritis.

The number of osteotomies has since steadily decreased. In 1981, Björn Tjörnstrand estimated in his dissertation “Tibial osteotomy for medial gonarthrosis” that one third of knee reconstructive surgery consisted of tibial osteotomies while in 1994 the knee arthroplasty register indicated that they only accounted for about 20% of the knee reconstructive surgeries.

Of the osteotomies performed around the knee, high tibial osteotomy is by far the most common method and is used in the vast majority of cases for medial osteoarthritis, and more rarely for lateral osteoarthritis. Distal femoral osteotomies are less common in Sweden and are mostly used for severe deformities, congenital or acquired, and for lateral osteoarthritis of the knee.

There are several different techniques for knee osteotomy and the initial fixation of the osteotomy is done in different ways depending on the method used. Closed wedge osteotomy is a “minus osteotomy” where a bone wedge, in size related to the determined degree of correction, is removed. The osteotomy can be fixated with a staple, a plate with screws, or with an external frame. Open wedge osteotomy is a “plus osteotomy” in which a wedge is opened-up to achieve the degree of correction. The fixation of the osteotomy can consist of an internal fixation or an external frame. An internal fixation includes a plate with screws or a staple and sometimes a bone graft or bone substitute (artificial bone). In open wedge osteotomy with an external fixation, it is possible to gradually open the osteotomy over a few weeks which is the biological procedure used for bone lengthening also known as hemicallostasis. Finally, there is also the curved, or “dome” osteotomy which is rare in Sweden. The results after knee osteotomy are related to the ability to achieve and maintain the predetermined correction of the malalignment, which requires achieving the predetermined degree of

correction during surgery and to have a stable fixation of the correction until the bone is healed.

Each technique has its advantages and disadvantages, and technology, materials and care are constantly evolving. Choice of method and technique of knee osteotomy can have an impact on the risk of complications in both the long and short term, as well as have an impact on a future knee replacement from both a technical and outcome perspective. Using the right technique on the right patient is also of importance from both a health economics and not least from a patient perspective.

Sweden was the first country in the world to start a national knee osteotomy registry as a complement to the knee replacement registration (W-Dahl et al. 2014). Australia started in autumn 2016 and New Zealand is planning to launch a comparable registration and, together with their joint replacement registers respectively have harmonised the report questionnaire after Sweden's to facilitate comparisons and collaboration in the future. The UK started its osteotomy registration in autumn 2014 and is funded by the industry and independent of the joint replacement register (Elson et al. 2015).

A total of 76 primary osteotomies from 19 units were reported in 2020. As figure 6.5.1 shows, there were only two hospitals reported 10 or more osteotomies during the year. The hospital that reported the most was Uddevalla with 17 procedures. In the pandemic year 2020 about 60% fewer knee osteotomies were reported than previous years from slightly fewer hospitals. How many of the osteotomies performed in the country are also being reported to the knee osteotomy register is difficult to assess. The procedure codes for knee osteotomy (NGK59 and NFK59) can be used for angle operation for reasons other than disease/injury of the knee. Information from the National Board of Health and Welfare showed that about 400 different diagnoses of which 148 main diagnoses had been registered for the procedure code NGK59 in the Patient Register (PAS). 65% of the operations could be ascribed to osteoarthritis and instability diagnoses. We extracted the number of NGK59 from the National Board of Health and Welfare's statistics for the years 2014–2019 and compared these with all primary osteotomies operated for osteoarthritis or instability in the osteotomy register for the corresponding years. Assuming that the osteotomy register, for the most part, captures osteoarthritis and instability diagnoses, we estimate that the completeness of the knee osteotomy register was 75–87% in 2014–2019.

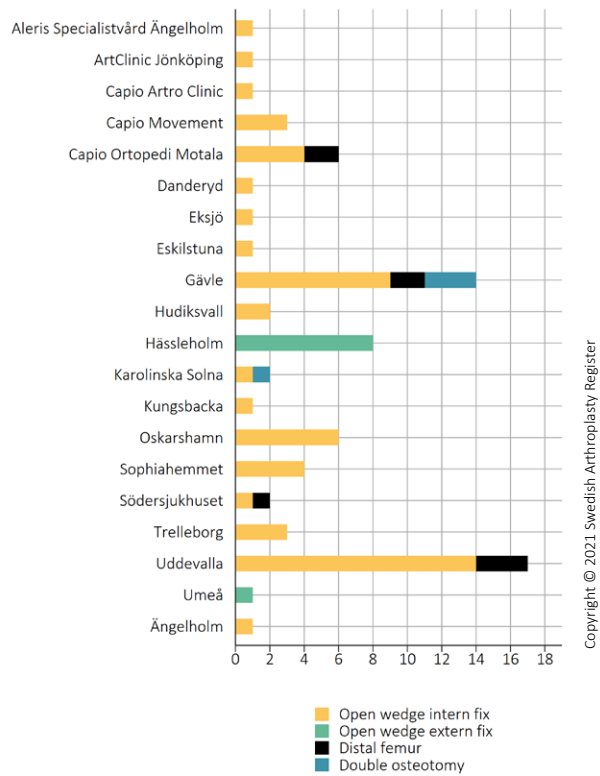


Figure 6.5.1. Number of knee osteotomies and method per unit 2020.



Figure 6.5.2. Closed wedge osteotomy fixed with a staple. The inserted picture above shows the wedge that is removed before the osteotomy is closed.



Figure 6.5.3. Open wedge osteotomy with internal fixation.



Figure 6.5.4. Open wedge osteotomy with external fixation.

Demography in knee osteotomy

	All	Proximal Tibia	Distal Femur
Number	76	64	8
Age			
Median (range)	53 (20–72)	52 (20–72)	48 (30–63)
< 45 years, n	19	15	4
45–54 years, n	28	26	1
55–64 years, n	27	21	3
65–74 years, n	2	2	0
75–84 years, n	0	0	0
≥ 85 years, n	0	0	0
Sex			
Female, n	27	20	6
BMI			
Number	75	63	8
Median (range)	27 (21–48)	27 (21–36)	31 (25–48)
< 18.5, n	0	0	0
18.5–24.9, n	41	14	1
25–29.9, n	13	36	2
30–34.5, n	5	8	4
35–40, n	1	5	0
>40, n	5	0	1
ASA class			
Number	76	64	8
I, n	39	35	2
II, n	29	23	5
III–V, n	8	6	1
Diagnosis OA			
Number	65	55	7
Ahlbäck 1, n	26	23	2
Ahlbäck 2, n	33	27	4
Ahlbäck 3–4, n	6	5	1
Compartment			
Number	65	55	7
Medial, n	60	55	2
Lateral, n	5	0	5
Preop HKA-angle			
Number	75	64	8
Median (range)	7 (0–25)	7 (0–25)	7 (1–13)

Table 6.5.1. Demography in knee osteotomies 2020.

Results

The knee osteotomy register registers the corresponding data as the knee arthroplasty register about the patients (BMI, ASA, previous surgeries), antibiotics and thrombosis prophylaxis and the surgical technique. In the case of knee osteotomy information on malalignment measured by HKA-angle and grade of osteoarthritis according to Ahlbäck classification is also asked for. The results are presented without percentages as the number of knee osteotomies was relatively low in 2020.

Demography, table 6.5.1

Almost two thirds of the patients were males, and the median age was 53 years, which compares with the median age for TKR in 2020 of 69 years and for UKR of 65.6 years. Almost half of the patients were reported to be healthy (ASA grade I) and had a median BMI of 27. Most of the patients were reported to have a medial osteoarthritis grade 1–2 according to the Ahlbäck classification and a median malalignment of 7 degrees varus or valgus. Patients operated on with a distal femur osteotomy were younger, most of them were female compared to those operated on with a proximal tibia osteotomy but had a similar degree of preoperative malalignment.

Previous surgery, table 6.5.2

When reporting previous surgery in the index knee more than one alternative may be entered. Almost half of the patients were reported to have had some form of knee surgery prior to the osteotomy and one fifth more than one surgery. This compares to knee replacement patients where just under 20% were reported to have had previous surgery in the index knee and 3% more than one surgery. The previous surgery reported is not comprehensive but illustrate what the surgeon knew at the time of the primary osteotomy.

Reason for and type of osteotomy, tables 6.5.3–4

The majority of the surgeries were performed for osteoarthritis. The most common method was open wedge osteotomy with internal fixation followed by open wedge with external fixation. No closed wedge osteotomies were reported in 2020.

Surgery	Number
None	34
Fracture surgery	2
Meniscal surgery	9
Cruciate surgery	10
Arthroscopi	12
Other	8
Missing	1
Total	76

Table 6.5.2. Previous surgery in the index knee.

Diagnosis	Number
Osteoarthritis	65
Acquired deformity	6
Congenital deformity	1
Instability	1
Local cartilage injury	1
Osteonecrosis	1
Other	1
Missing	0
Total	76

Table 6.5.3. Reason for surgery.

Type	Number
Open wedge internal fixation	55
Open wedge external fixation	9
Distal femur osteotomy	8
Double osteotomy	4
Missing	0
Total	76

Table 6.5.4. Type of osteotomy.

Open wedge osteotomy with internal fixation, table 6.5.5

Several different plates for the fixation of the osteotomy have been reported. The Tomofix-plate is the most frequently reported in open wedge osteotomy with internal fixation. Four different types of plate fixation have been used with the osteotomies with this technique.

Open wedge osteotomy with external fixation

In open wedge osteotomy with external fixation only use of Orthofix was reported in 2020.

Type	Number
Tomofix	37
Puddo	7
PEEKPower	5
iBalance	6
Missing	0
Total	55

Table 6.5.5. Type of fixation in open wedge osteotomy with internal fixation.

Bone graft	Number
None	33
Auto graft	2
Bank bone	2
Synthetic bone	18
Missing	0
Total	55
Synthetic bone	
ChronOS	8
INNOTERE	5
Osferion	5
Total	18

Table 6.5.6. The use of bone graft in open wedge osteotomy with internal fixation.

Bone grafting, table 6.5.6

In just under two thirds of open wedge osteotomies with internal fixation it was reported that no bone grafting had been used. When bone grafting was used synthetic bone was reported most frequently, in the form of ChronOS from DePuy.

Distal femur osteotomy, table 6.5.7

For distal femur osteotomies, different types of fixations were reported and Tomofix was the most common.

Concomitant surgery, table 6.5.8

At the same time as the knee osteotomy, it was reported that an additional procedure was performed for 13 of the 76 operations. Arthroscopy was most frequently reported.

Type	Number
Tomofix	4
Puddo	1
Other	2
Missing	1
Total	8

Table 6.5.7. Type of fixation in distal femur osteotomy.

Surgery	Number
None	63
Arthroscopi	11
Cruciate surgery	0
Meniscal surgery	0
Other	1
Missing	1
Total	76

Table 6.5.8. Concomitant surgery with the knee osteotomy.

Type of anaesthesia, table 6.5.9

General anaesthesia was the most frequently reported form of anaesthesia and was reported for more than two thirds of cases.

Operating time, table 6.5.10

The median operating time, where the osteotomies with other concomitant surgery were excluded, was shorter for open wedge osteotomies with external fixation (29 min, 23–87 min) than for internal fixation (51 min, 25–135). The median time for distal femur osteotomy was 56.5 min (43–110) and for double osteotomy was (112 min, 110–122). Table 6.5.10 shows the median times including the operation time for a possible concomitant surgery.

Type	Number
General	52
Spinal	24
Epidural	0
Missing	0
Total	76

Table 6.5.9. Type of anaesthesia.

Type of osteotomy	Minutes	Range
Open wedge internal	58	25–135
Open wedge external	29	23–87
Distal femur	56.5	43–110
Double osteotomi	117	110–248

Table 6.5.10. Surgical time including concomitant surgery.

Computer-aided surgery (CAS)

None of the osteotomies were reported to have been performed with computer-aided surgery (CAS).

Thrombosis prophylaxis, tables 6.5.11–12

Tinzaparin and Dalteparin were the most commonly reported antithrombotic drugs. Prophylaxis with Dalteparin, Tinzaparin and Enoxaparin were more often started postoperatively. In five of the operations, it was reported that no thrombosis prophylaxis at all was used. The duration of prophylaxis varied but in three quarters of the operations, prophylaxis was planned for 8–14 days.

Prophylaxis – time	Number
No prophylaxis	5
Dalteparin preop	1
Dalteparin postop	35
Tinzaparin postop	30
Enoxaparin postop	3
Apixaban	1
Rivaroxaban	1
Missing	0
Total	76

Table 6.5.11. Antithrombotic prophylaxis.

Days	Number
No prophylaxis	5
0–7	8
8–14	59
15–21	1
22–28	3
29–35	0
>35	0
Missing	0
Total	76

Table 6.5.12. Antithrombotic prophylaxis – planned duration of treatment.

Prophylactic antibiotics, tables 6.5.13–15

Cloxacillin and Clindamycin have been reported as infection prophylaxis for all surgeries in 2020. Clindamycin has been reported in two of the operations (table 6.5.13). Corresponding for the knee replacement in 2020 was just under 5%. Since Clindamycin has been shown to have a higher risk of revision due to infection in knee replacement (Robertsson et al. 2017) the PRISS recommendations have been updated in April 2018 (www.patientforsakringen.se). In more than half of the operations it was planned to use 2 g×3 Cloxacillin the first day of surgery as prophylaxis while a quarter were planned to receive a single dose of 2 g (table 6.5.14). At the time of

surgery, the concentration of antibiotic in the tissues should be sufficient to counteract any bacteria in the area. As Cloxacillin has a short half-life it is important that it is administered at the correct time-interval.

In November 2017, updated recommendations were published from the PRISS-project (www.patientforsakringen.se) where the optimal time is 45–30 min before the start of surgery, a narrower range than previously recommended (45–15 min). In one third of the osteotomies, the preoperative dose was reported had been given according to PRISS-recommendations (table 6.5.15) and slightly more (32/79) within the previously recommended range.

Drug	Number
Cloxacillin	74
Clindamycin	2
Missing	0
Total	76

Table 6.5.13. Prophylactic antibiotics – drug.

Dose	Number
2g × 1	20
2g × 2	11
2g × 3	43
Other	2
Missing	0
Total	74

Table 5.5.14. Dosage of Cloxacillin.

Minutes before surgery	Number
0–29	14
30–45	26
>45	30
Given postop	1
No antibiotics administrated	0
Missing	5
Total	76

Table 6.5.15. Prophylactic antibiotics – time of administration (number of minutes before surgery) (PRISS recommendation).

Tourniquet and drainage, table 6.5.16

The use of tourniquet has decreased among Swedish orthopaedic surgeons but is reported slightly more frequently in knee osteotomies (just over half) than in knee replacements (31%). Using drainage has become increasingly rare. All osteotomies were reported to be performed without the use of drainage and corresponding numbers for knee replacements was less than 0.2%.

Reoperation

Since the start of the knee osteotomy register in 2013 more than 80 reoperations have been reported. The most

common reasons for reoperation have been pain/irritation from the plate, pseudo-arthritis/delayed healing and over or under correction.

Conversion to TKR, figure 6.5.5

The cumulative revision rate (CRR) at six years for open wedge osteotomies operated with internal or external fixation between 2013–2020 and followed through 31st of December 2020 were 13.8 (95% CI 10.2–17.2) and 12.6 (95% CI 6.1–17.6) respectively.

Tourniquet	Number
Yes	44
No	32
Missing	0
Total	76

Drainage	Number
Yes	0
No	76
Missing	0
Total	76

Table 6.5.16. The use of tourniquet and drainage.

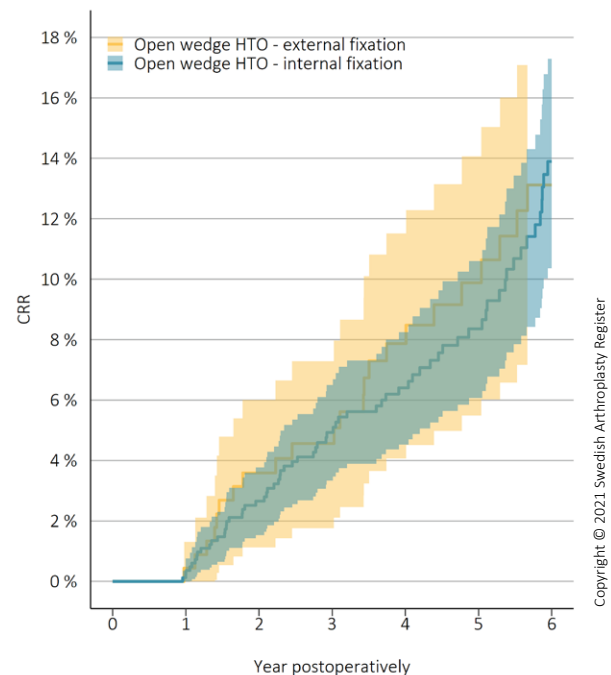
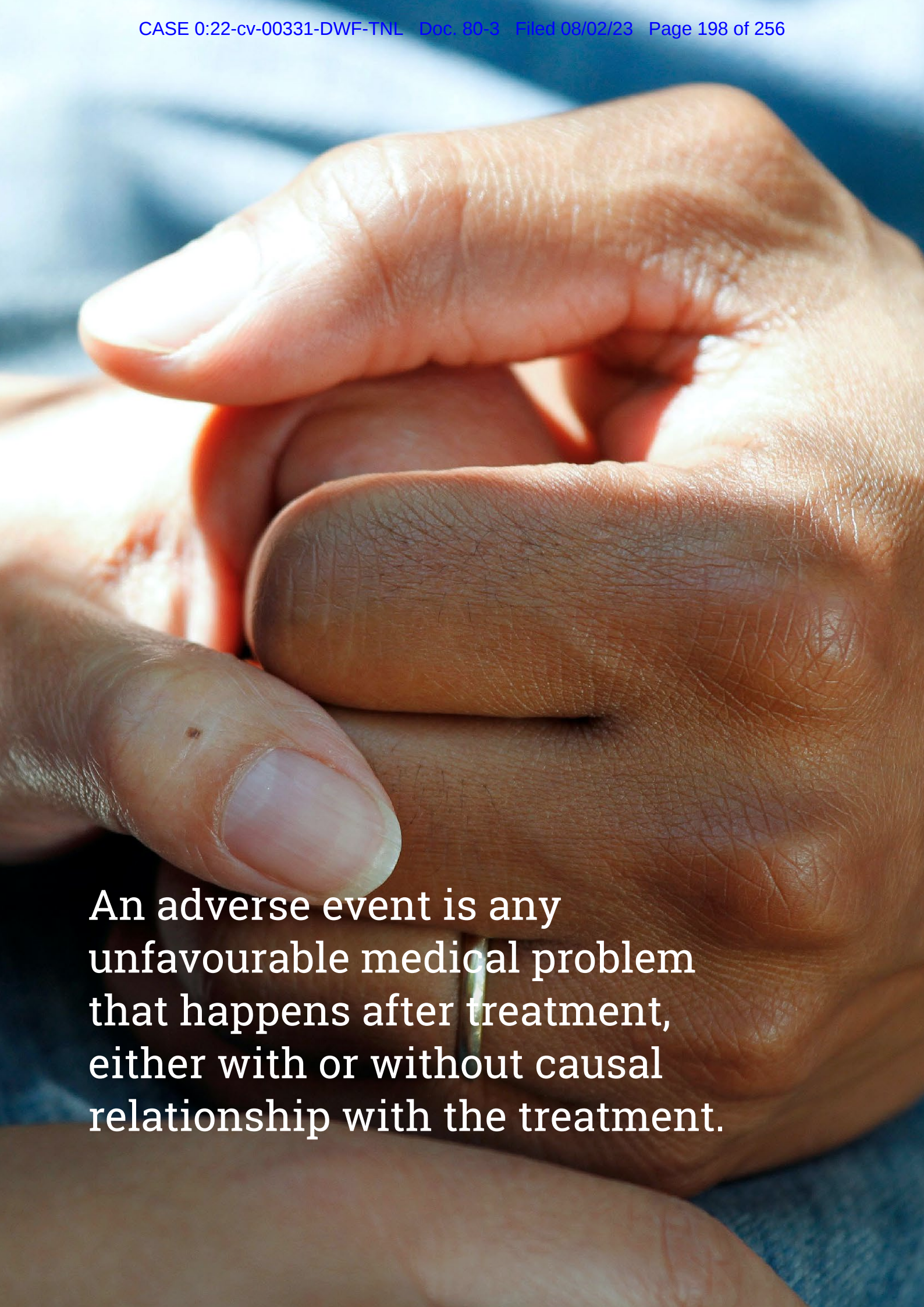


Figure 6.5.5. CRR for conversion to TKR after open wedge osteotomy.



An adverse event is any unfavourable medical problem that happens after treatment, either with or without causal relationship with the treatment.

7. Adverse events

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7.1 Mortality within 90 days

90-day mortality is often used to assess risks with various medical treatments and is an openly reported variable. This year's report, report on unit level for hip fractures and regional level for primary hip and knee replacement surgery. The Swedish Arthroplasty Register's database is updated each night regarding potential date of deaths from the Swedish Tax Agency. The presentation includes the last three years (2017–2019) in an attempt to compensate for the risk of random variation.

A planned orthopaedic operation is usually performed when the health of the individual is in such a stable state as possible. Sometimes the risks of surgery are so great that surgery is not recommended. This selection and optimisation of the elective patients makes the mortality low, the age- and sex-weighted mortality within 90 days of primary total hip replacement for osteoarthritis is 1.3‰ (table 7.1.1). However, the mortality differs between the regions. The lowest mortality is around 1.2‰ in three regions, while three other regions have a mortality around 2‰. The mortality after knee replacement is even lower, 0.6‰ (table 7.1.2). Also after knee replacement the variation is large between regions. Note that there are two smaller regions with the highest mortality, the variability may be bigger for them. It is notable that Halland has a comparatively high mortality after hip replacement, but after knee replacement Halland is among the lowest in the country. Blekinge and Gotland have the opposite pattern,

low mortality after hip arthroplasty and high mortality after knee arthroplasty.

Joint replacement surgery involves an increased risk for potentially life-threatening complications, such as infections and thromboembolic events. Accurate information is important before the decision to undergo a planned surgery, and even if the mortality seems low there may be room for improvement. If an individual suffers complications after joint replacement, it is of utmost importance that the orthopaedic surgeon is informed about this, to get feedback.

A patient with hip fracture is an emergency case and will, in most cases, have surgery regardless of comorbidities. The mortality within 90 days after hip fracture surgery is therefore high, the national average is 13%. Some units lie even higher, around 16%. Although it may possibly be explained by a large proportion of very ill patients (Växjö, Karlskoga) and male patients respectively (male entails a greater risk of death after fracture) (Växjö, Kristianstad, Sundsvall, Aleris Specialistvård Motala, NÄL), and more elderly patients (Aleris Specialistvård Motala, NÄL, Kristianstad) the figures should induce to internal analysis. The units that have markedly low mortality perform less frequently emergency surgeries, their fracture patients undergo planned secondary surgery.

90-days mortality after primary hip replacements due to OA

Region	Number of operations	Number of deaths	Mortality (weighted), ‰
Country	58,012	94	1.3
Blekinge	972	1	0.7
Dalarna	1,408	3	1.6
Gotland	448	0	0.0
Gävleborg	1,696	2	2.1
Halland	2,918	6	2.1
Jämtland	777	2	2.4
Jönköping	2,309	1	0.3
Kalmar	2,136	2	1.2
Kronoberg	996	1	0.7
Norrbottn	1,959	4	1.3
Skåne	6,144	12	1.4
Stockholm	13,48	25	1.4
Sörmland	1,717	2	1.0
Uppsala	1,933	1	0.2
Värmland	1,479	3	1.5
Västerbotten	1,67	3	1.0
Västernorrland	1,564	3	1.3
Västmanland	1,150	2	1.5
Västra Götaland	8,563	19	1.7
Örebro	1,967	1	0.3
Östergötland	2,726	1	0.2

Table 7.1.1. 90-day mortality after primary hip replacement – OA per region 2017–2019.

90-days mortality after primary total knee replacement due to OA

Region	Number of operations	Number of deaths	Mortality (weighted), ‰
Country	52,970	51	0.64‰
Blekinge	929	1	1.54‰
Dalarna	1,262	2	1.01‰
Gotland	393	1	5.6‰
Gävleborg	1,694	1	0.4‰
Halland	2,903	2	0.38‰
Jämtland	590	1	0.98‰
Jönköping	2,400	1	0.23‰
Kalmar	2,091	1	0.99‰
Kronoberg	630	1	0.94‰
Norrbottn	1,432	3	1.2‰
Skåne	7,507	10	0.82‰
Stockholm	11,447	10	0.37‰
Sörmland	1,320	2	0.7‰
Uppsala	1,799	1	0.24‰
Värmland	1,590	2	0.89‰
Västerbotten	1,290	2	1‰
Västernorrland	1,228	1	0.82‰
Västmanland	904	1	0.6‰
Västra Götaland	7,945	5	0.64‰
Örebro	1,612	1	0.3‰
Östergötland	2,004	2	0.54‰

Table 7.1.2. 90-day mortality after primary knee replacement – OA per region 2017–2019.

90-days mortality after acute hip fracture

Unit	Number of operations ¹⁾	> 80 years ²⁾	Males ³⁾	ASA III ⁴⁾	ASA IV ⁵⁾	Acute fracture ⁶⁾	Mortality ⁷⁾
Country	25 446	58.8%	35.6%	54.7%	6.2%	92.9%	13%
Akademiska sjukhuset	913	55,6%	35,4%	61,2%	6,1%	92,7%	13,8%
Aleris Specialistvård Motala	89	69,7%	42,7%	64%	2,3%	76,4%	15,7%
Alingsås	198	62,6%	43,4%	56%	10,4%	96,5%	14,9%
Borås	545	63,5%	35,2%	48,8%	5,3%	98%	13,2%
Capio S:t Göran	804	62,9%	37,7%	62,2%	9,3%	90,7%	13,1%
Danderyd	1 098	60,6%	30,9%	64,6%	4,5%	88,3%	11,4%
Eksjö	244	57%	33,6%	50,6%	2,6%	95,5%	9,2%
Eskilstuna	456	56,4%	31,4%	50,4%	2,9%	92,1%	15%
Falun	556	59,7%	37,6%	55%	8,5%	94,6%	12,5%
Gällivare	179	52%	37,4%	48%	7,3%	98,3%	11,9%
Gävle	634	54,4%	38,2%	43,6%	5,3%	95,9%	13,5%
Halmstad	424	64,2%	31,4%	43,9%	6,4%	92,7%	10,9%
Helsingborg	776	62,4%	32,1%	48,8%	4,6%	94,1%	13,9%
Hudiksvall	353	60,1%	34,8%	46,3%	4,5%	92,6%	15,4%
Hässleholm	83	27,7%	33,7%	43,8%	0%	6%	3,6%
Jönköping	363	62,3%	36,1%	60,8%	9,4%	96,4%	11,3%
Kalmar	389	58,4%	35,7%	51%	4,4%	96,4%	11%
Karlskoga	350	57,7%	35,1%	52%	8,4%	99,7%	16%
Karlskrona	526	63,5%	35,4%	42%	3,3%	97,7%	13,6%
Karlstad	755	59,3%	35,5%	54,8%	7,2%	95,5%	13,8%
Kristianstad	620	64,2%	36%	60,5%	5,8%	98,1%	16,8%
KS/Huddinge	502	54,8%	34,3%	65%	8,2%	88,8%	13,7%
KS/Solna	144	45,1%	41%	67,9%	6,9%	76,4%	11,3%
Kungälv	325	56,9%	28,9%	45,2%	6,8%	95,1%	13,2%
Lidköping	241	60,6%	30,7%	48,1%	1,7%	88,8%	11,9%
Lindesberg	215	38,1%	34%	44,7%	7%	77,2%	8,9%
Linköping	452	61,1%	35,4%	51,4%	10,3%	94%	12,2%
Ljungby	179	64,2%	29,1%	54,7%	1,7%	93,9%	10,4%
Lycksele	130	53,1%	36,9%	57,3%	2,6%	92,3%	13,4%
Mora	322	56,5%	38,5%	42%	10%	92,5%	8,7%
Norrköping	482	59,8%	33,2%	49,3%	7,1%	93,4%	12,5%
Norrtälje	188	56,9%	32,4%	65,4%	9,6%	95,2%	14,6%
Nyköping	245	62%	36,7%	50,8%	3,3%	90,2%	14,9%
NÄL	965	62,8%	35,9%	61,5%	8%	98,4%	15,3%

90-days mortality after acute hip fracture, cont.

Unit	Number of operations ¹⁾	> 80 years ²⁾	Males ³⁾	ASA III ⁴⁾	ASA IV ⁵⁾	Acute fracture ⁶⁾	Mortality ⁷⁾
Piteå	34	14,7%	38,2%	29,4%	0%	5,9%	0%
Skellefteå	247	53,8%	42,1%	41,6%	5,9%	91,1%	13,6%
Skövde	482	55,6%	33%	42,1%	4%	95%	14,3%
SU/Mölnådal	1 594	59,7%	35,1%	50,8%	5,6%	95,3%	14,6%
Sunderby sjukhus	522	59,6%	40,8%	61,5%	9,4%	98,1%	13,2%
Sundsvall	458	58,5%	36,5%	53,1%	7,6%	96,7%	15,9%
SUS/Lund	843	55,4%	38,9%	54,1%	4,1%	93%	11%
SUS/Malmö	862	60%	36,1%	67,7%	5,6%	97,8%	14,2%
Södersjukhuset	1 306	59,5%	34,5%	63,4%	5,2%	89,5%	11,5%
Södertälje	268	53%	30,2%	66,4%	4,5%	95,5%	9,6%
Torsby	126	63,5%	45,2%	56%	8%	98,4%	13%
Trelleborg	49	18,4%	32,7%	18,8%	0%	0%	0%
Uddevalla	28	32,1%	32,1%	35,7%	7,1%	0%	7,8%
Umeå	428	59,6%	38,6%	58,5%	10,3%	95,6%	13,8%
Varberg	406	63,8%	32,3%	49,5%	4,8%	94,3%	12,1%
Visby	162	51,2%	34%	46,7%	3,6%	94,4%	10,1%
Värnamo	196	63,3%	36,2%	46,6%	6,9%	95,4%	10,3%
Västervik	236	59,7%	34,7%	46,1%	2,9%	91,9%	11,4%
Västerås	729	57,3%	38,8%	61,2%	5,7%	93,6%	13,3%
Växjö	314	62,1%	38,9%	53,8%	14%	93,9%	16,4%
Ystad	268	65,3%	39,6%	57,9%	5,7%	100%	14,8%
Örebro	249	59,8%	37,3%	54,8%	9,7%	90%	10,9%
Örnsköldsvik	368	59,2%	36,4%	60,6%	10%	94,6%	12,2%
Östersund	439	55,1%	36,7%	48,7%	7,5%	93,6%	11,8%

Table 7.1.3. 90-day mortality after acute fracture per unit

1) Refers to the number of primary operations in the current period. Units with less than 20 primary operations in the current period are excluded.

2) Refers to number of operations in the age group >80 years.

3) Refers to the proportion of males in the current period.

4) Proportion with ASA class III.

5) Proportion with ASA class IV.

6) Proportion with acute fracture.

7) 90-day mortality (proportion who have died within 90 days after surgery).

7.2 Adverse events

Joint replacement considerably improves quality of life and it is one of the most cost effective interventions. Although the procedure is considered safe with few complications, some patients experience health problems that may have been caused by, or become symptomatic as a result of the surgery.

Description of the analysis

The analysis is based on data from the register and the Patient Register of the National Board of Health and Welfare (PAR). We have examined the diagnostic and procedure codes that have been reported to the PAR during and after hip and knee replacement surgery and have identified codes that may represent adverse events during the hospital stay or during readmissions within 90 days of the surgery (see table 7.2.1). Because it often takes until late in the year before the PAR data is complete for the previous year, we have chosen to include data until October 1, 2019 to be able to get complete 90-day follow-up. This year, the National Board of Health and Welfare has delivered adverse events after 30 and 90 days per unit for hip replacement surgery and per region for knee replacement surgery.

The analysis includes elective hip replacements and total knee replacements for osteoarthritis, hip replacements due to hip fracture and those having first-time revision of primary hip and knee replacements. The analyses include partly, 2010–2019, and partly the most recent three-year period, 2017–2019. If both hips/knees have been operated within 90 days only the latter is included and only one hip or one knee if both have been operated the same day. The Swedish Arthroplasty Register sends data on all registered operations to the National Board of Health and Welfare which performs the match against PAR, and codes corresponding to the definition of adverse events, during or after the hospital stay, up to 90 days after the surgery is sought.

The codes were divided into the following groups (table 7.2.1):

- A) Surgical procedure codes that include reoperations of hip or knee implants and other procedures that may represent a complication.
- DA) Diagnosis codes that imply surgical complications.
- DB) Diagnosis codes that cover hip/knee-related diseases that may have been used for complication after hip/knee replacement surgery.
- DC) Diagnosis codes covering cardiovascular events that may be related to the surgery.
- DM) Diagnosis codes concerning other medical events not related to the hip/knee but may be related to the surgery if they occur shortly afterwards.

Sources of error

The definition of an adverse event is based on diagnostic and procedure codes. There may be differences between regions and units in how carefully the coding has been performed during hospital stays. Information on death after surgery is not dependent on coding. Inadequate registration in the PAR of surgical dates during the hospital stay can result in adverse event not being included. Some units performing hip and knee replacement surgery do not report to the PAR and for those, adverse events occurring during the admission will not be included in the indicator.

As the information in the PAR on laterality of the surgery is uncertain a complication in the opposite hip/knee will count as an adverse event. However, we consider it unlikely that a complication or a procedure will be registered in the opposite hip/knee within 90 days of surgery.

The fact that only adverse events which occur during the primary admission or during readmission are included is a weakness of the analysis. Outpatient care is not included. A patient who has closed reduction of her dislocation in an emergency unit and returns to home is not included. This applies as well, for example, to peripheral venous thrombosis which usually does not lead to inpatient care. Furthermore, the coding routines between different regions and units differ. In some cases, there may exist DRG-creep (diagnosis related groups). The threshold for including certain complication codes differs between units. The most important thing is to follow the unit's result over time and to stimulate local analysis in order to better understand the panorama of adverse events and thereby identify areas of improvement. To compare results between units is not the primary purpose of the quality indicator.

Finally, it is important to realize that many adverse events do not have to be causally related to the surgery. For example, a patient might have a heart attack or die even without surgery. This implies that regional differences in general health (case-mix), the access to healthcare and preventive medicine may influence the outcome.

Results

In both knee and hip replacement surgery, elective primary procedures are distinguished. For knees, total replacement for osteoarthritis are reported and for hips, elective total replacements (including all diagnoses except hip fracture) and first-time revisions (figures 7.2.1 and 7.2.2). For hip replacements patients with hip fractures are reported separately, as they differ from those having elective surgery for osteoarthritis. Those with fracture are older, sicker and in need of immediate surgery. In addition, they have the highest incidence of adverse events, about one third are affected during the first 90 days. The incidence of adverse

events is fairly the same regardless of if the patient has undergone primary elective hip or a knee replacement surgery. This proportion is however 10% higher in revisions after primary hip replacement compared with revision after primary knee replacement. We have not analysed the reasons for this, but one possible explanation may be that a number of fracture patients also need revision surgery and then brings their increased risk into the group. It is gratifying that the incidence of adverse events is decreasing after both primary hip and knee replacement during the 2010s. Unfortunately, the incidence is increasing after hip revision (figures 7.2.1 and 7.2.2). Surgical adverse events, however, are essentially stationary after hip revision and decreasing after all other procedures/diagnoses (figures 7.2.3 and 7.2.4).

The results of each unit must be seen in the light of its case-mix. Therefore, both the proportion of adverse events per unit and for "the standard patient" (standardised case-mix) are presented for hip replacement (figures 7.2.5 and 7.2.6) and for the fracture patients (figure 7.2.7). Units with deviating result here should carry out local improvement work. As for the proportion of adverse events after hip replacement possibly case-mix and varying degree of complicated revisions are part of the explanation of a varying outcome (figure 7.2.8). Proportion of adverse events after total knee replacement for osteoarthritis shows relatively large variations between the regions. As in previous years, Västerbotten has the highest proportion of adverse events within 90 days and Halland has the lowest (table 7.2.2).

Codes for adverse events

			HIP ICD-10 and NOMESCO codes	KNEE ICD-10 and NOMESCO codes	
Unit	Used for primary surgeries	Used for reoperations and revisions	Additional codes for fractures		
Surgical					
A NOMESCO codes Complications and suspected complications	If the procedure occur after the operation date OR during an admission after the operation	If the proucedure occur during an admission after the operation	Exact code NFA02, NFA11, NFA12, NFA20, NFA21, NFA22, NFK09, NFU09, NFU19, NFU39, NFU89, NFU99, QDA10, QDB00, QDB05, QDB99, QDE35, QDG30, TNF05, TNF10 Start with NFC..., NFF..., NFG..., NFH..., NFJ..., NFK..., NFL..., NFM..., NFL..., NFM..., NFS..., NFT..., NFW..		Exact code NFQ09, NFQ19, NFQ99, NGB59* NGF01, NGF02, NGF10, NGF11, NGF12, NGF91, NGF92, NGK09, NGK19, NGM09, NGQ09, NGT09, NGT19, QDA10, QDE35, TNG05, TNG10 Start with NGA..., NGC..., NGE..., NGG..., NGH..., NGJ..., NGL..., NGS..., NGU..., NGW..., QDB..., QDG..
	If the procedure occur during an admission after the operation	If the procedure occur during an admission after the operation	NFU49		NGB59
DA ICD-10 codes Surgical complications	If they occur as main or co-diagnosis at the time for surgery or as main code at re-admission	If they occur as main diagnosis at re-admission	G978, G979, M966F, M968, M969, T810, T812, T813, T814, T815, T816, T817, T818, T818W, T819, T840, T840F, T843, T843F, T844, T845, T845F, T847, T847F, T848, T848F, T849, T888, T889		G978, G979, M966G, M968, M969, T810, T812, T813, T814, T815, T816, T817, T818, T818W, T819, T840, T840G, T843, T843G, T844, T844G, T845, T845G, T847, T847G, T848, T848G, T849, T888, T889
DB ICD-10 codes for hip/knee related conditions	If they occur as main or co-diagnosis at the time for surgery or as main code at re-admission	If they occur as main diagnosis at re-admission	G570, G571, G572, M000, M000F, M002F, M008F, M009F, M243, M244, M244F, S730. Start with S74..., S75..., S76..		G573, G574, M000, M000G, M002G, M008G, M009G, M220, M221, M236, M244G, M621G, M662G, M663G, M843G, S342, S800, S810, S830, S831, S834L, S834M, S835R, S835S, S835X, S840, S841
	If they occur as main diagnosis at re-admission	If they occur as main diagnosis at re-admission	M240F, M245F, M246F, M610F, M621F, M662F, M663F, M843F, M860F, M861F, M866, M866F, M895E		M235, M240, M245, M246, M256, M659G, M860G, M861G, M866, M866G, M895G

			HIP ICD-10 and NOMESCO codes	KNEE ICD-10 and NOMESCO codes	
Unit	Used for primary surgeries	Used for reoperations and revisions	Additional codes for fractures		
Cardiovascular					
DC ICD-10 codes for serious cardiovascular conditions	If they occur as main or co-diagnosis at the time for surgery or as main code at re-admission	If they occur as main or co-diagnosis at the time for surgery or as main code at re-admission	Exact code I260, I269, I460, I461, I469, I490, I649, I770, I771, I772, I819, I978, I979, J809, J819, T811 Start with I21., I24., I62., I63., I65., I66., I72., I74., I60., I61., I82..		Exact code I260, I269, I460, I461, I469, I490, I649, I770, I771, I772, I819, I978, I979, J809, J819, T811 Start with I21., I24., I60., I61., I62., I63., I65., I66., I72., I74., I82..
Medical					
DM ICD-10 codes for other medical conditions	If they occur as main or co-diagnosis at the time for surgery or as main code at re-admission	If they occur as main or co-diagnosis at the time for surgery or as main code at re-admission	Exact code J952, J953, J955, J958, J959, J981, N990, N998, N999, R339 Start with I80., J13., J14., J15., J16., J17., J18., J96., K25., K26., L89., N17..	N300, N308, N309, N390	Exact code J952, J953, J955, J958, J959, J981, N990, N998, N999, R339, Start with L89., I80., J13., J14., J15., J16., J17., J18., K25., K26., K27., N17..
	If they occur as main diagnosis at re-admission	If they occur as main diagnosis at re-admission	Exact code K590, N991 Start with J20., J21., J22., K29..		Exact code K590, N991 Start with J20., J21., J22., K29..

Table 7.2.1. Codes for adverse events.

* Only for readmission.

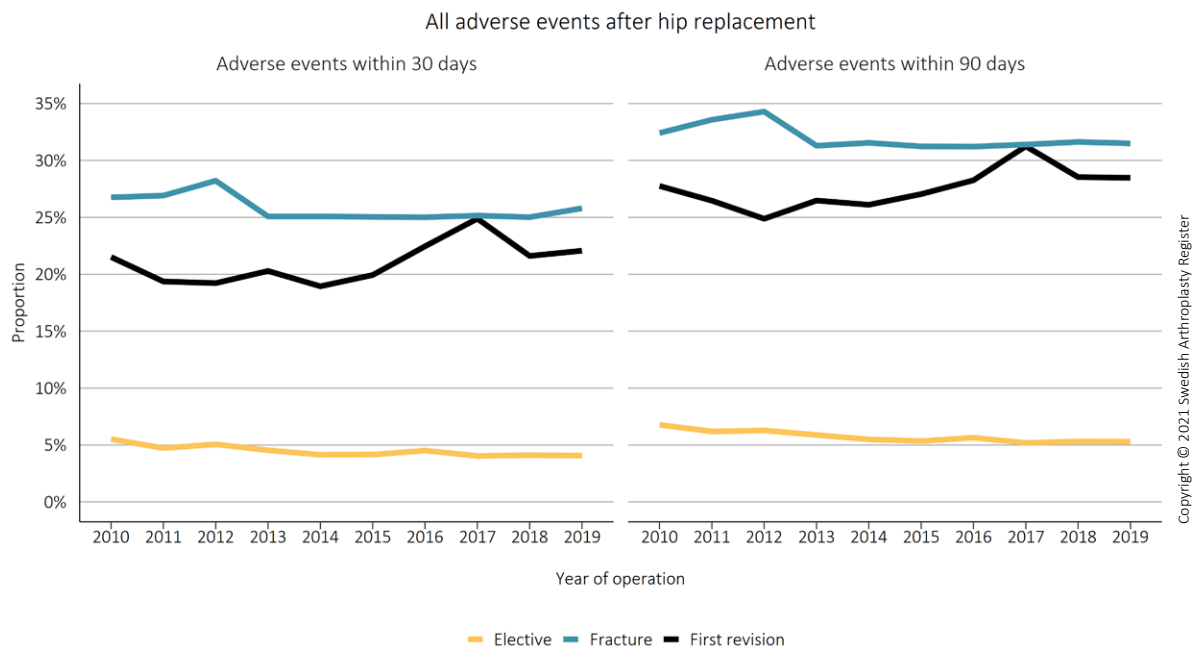


Figure 7.2.1. Adverse events within 30 and 90 days after primary hip replacement and hip revision 2010–2019.

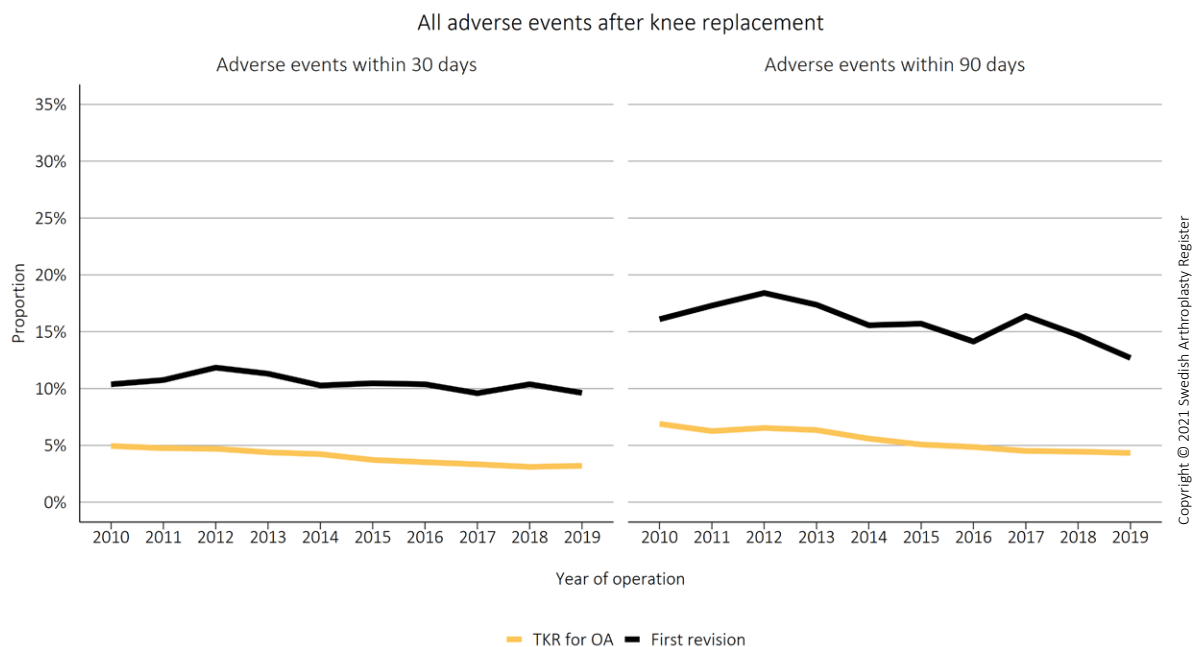


Figure 7.2.2. Adverse events within 30 and 90 days after primary total knee replacement and knee revision 2010–2019.

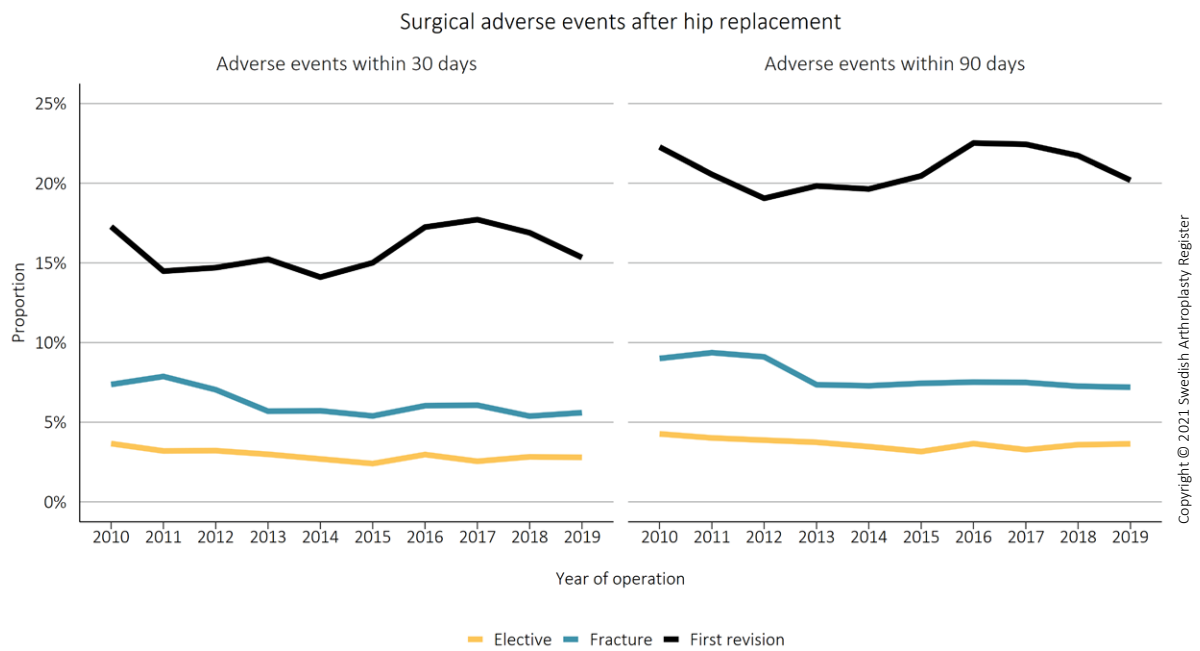


Figure 7.2.3. Adverse surgical events within 30 and 90 days after primary hip replacement and hip revision 2010–2019.

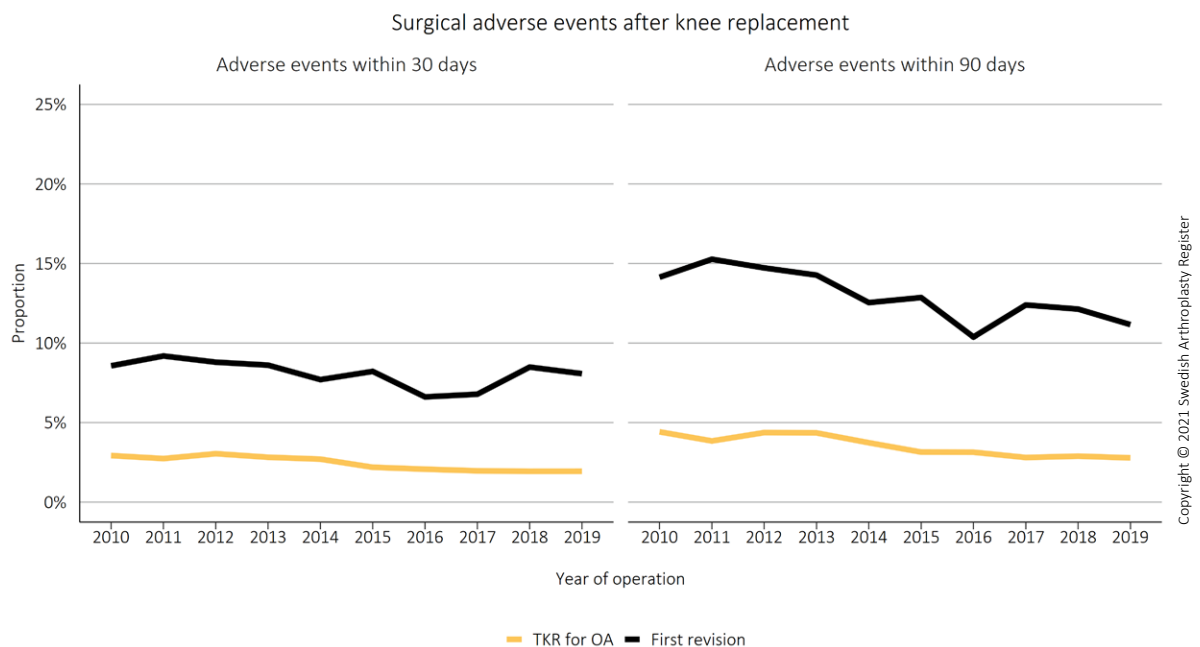


Figure 7.2.4. Adverse surgical events within 30 and 90 days in primary total knee replacement and knee revision 2010–2019.

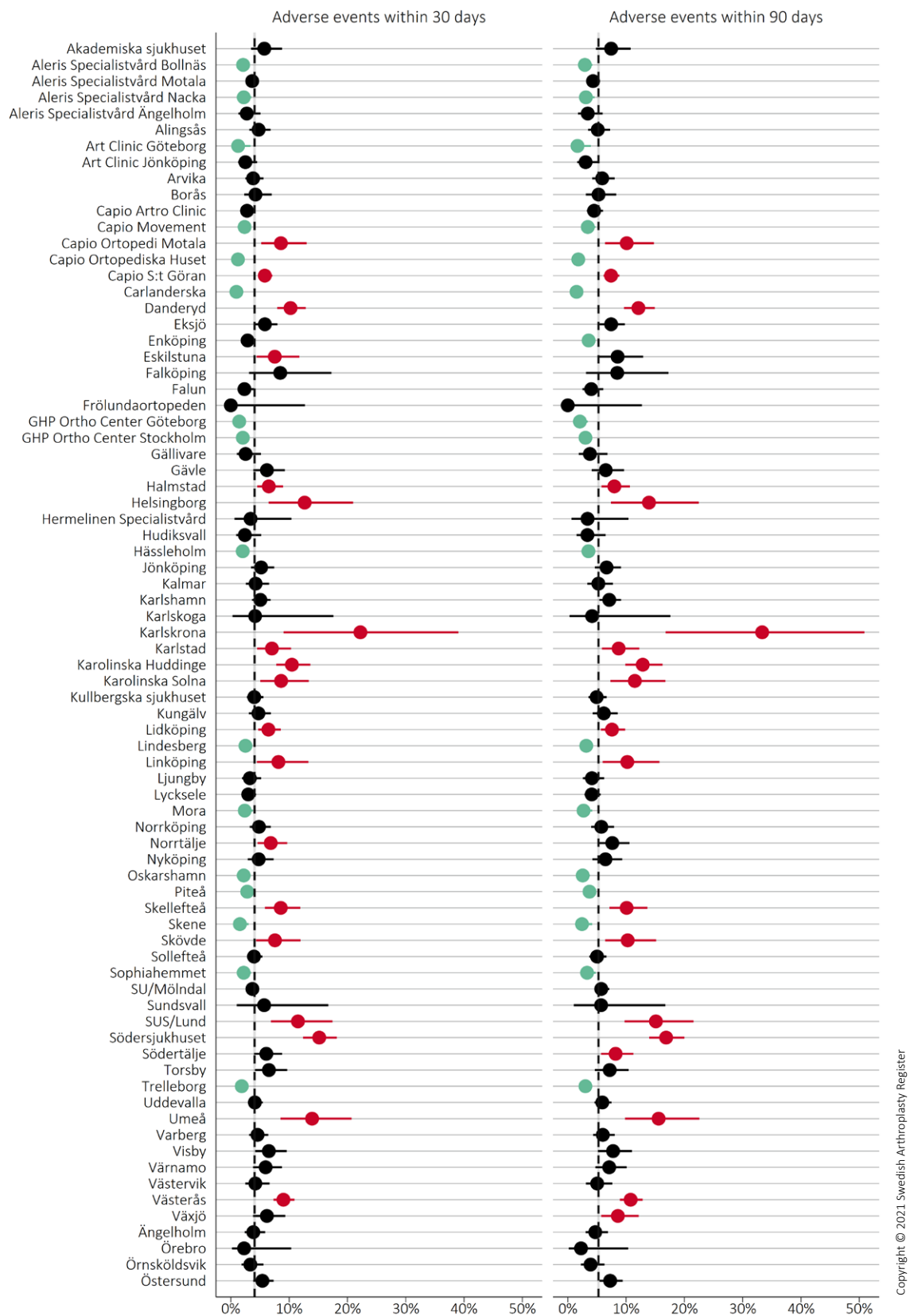


Figure 7.2.5. Adverse events per unit 2017–2019, elective hip replacement.

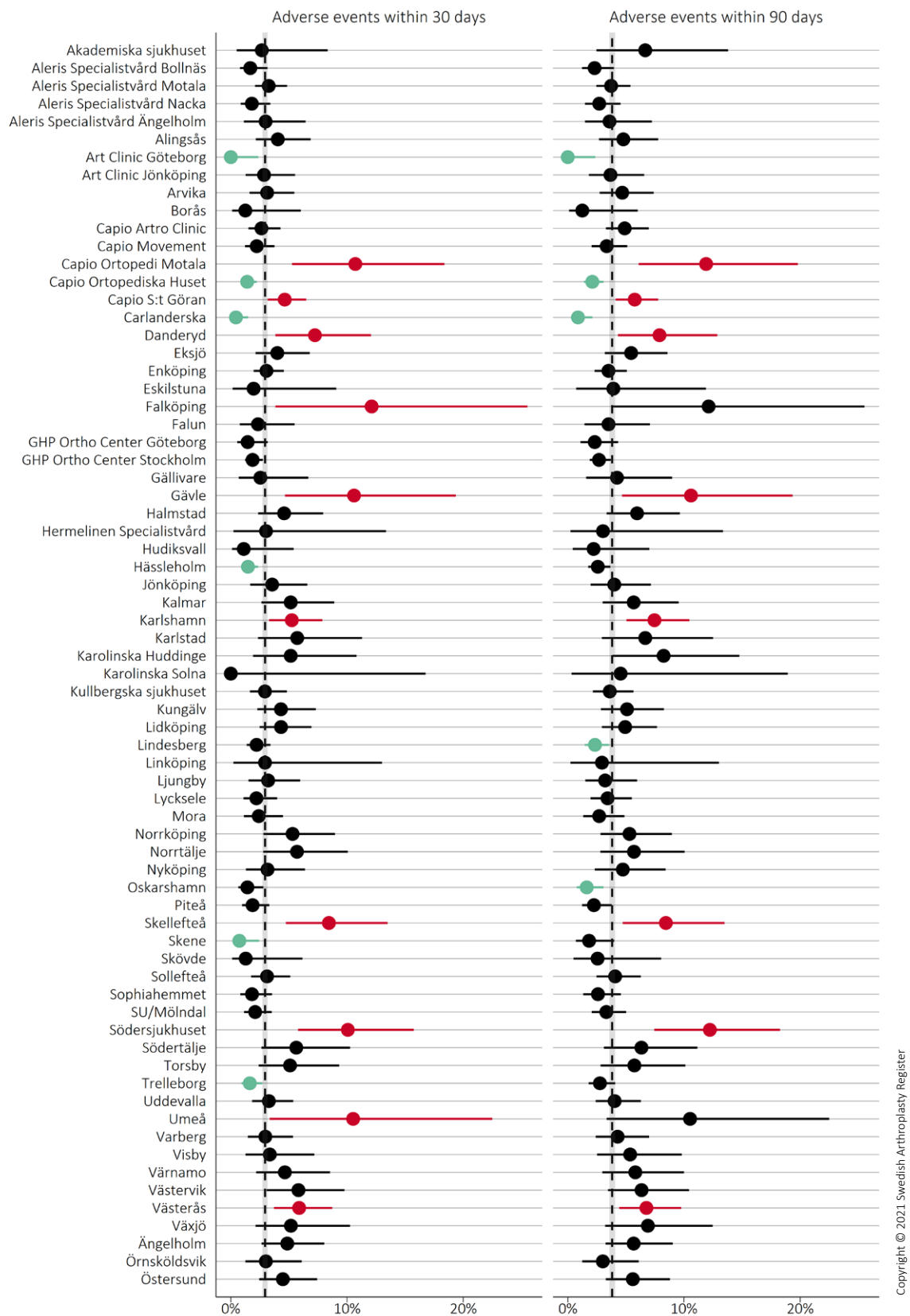


Figure 7.2.6. Adverse events per unit 2017–2019, “standard patient”.

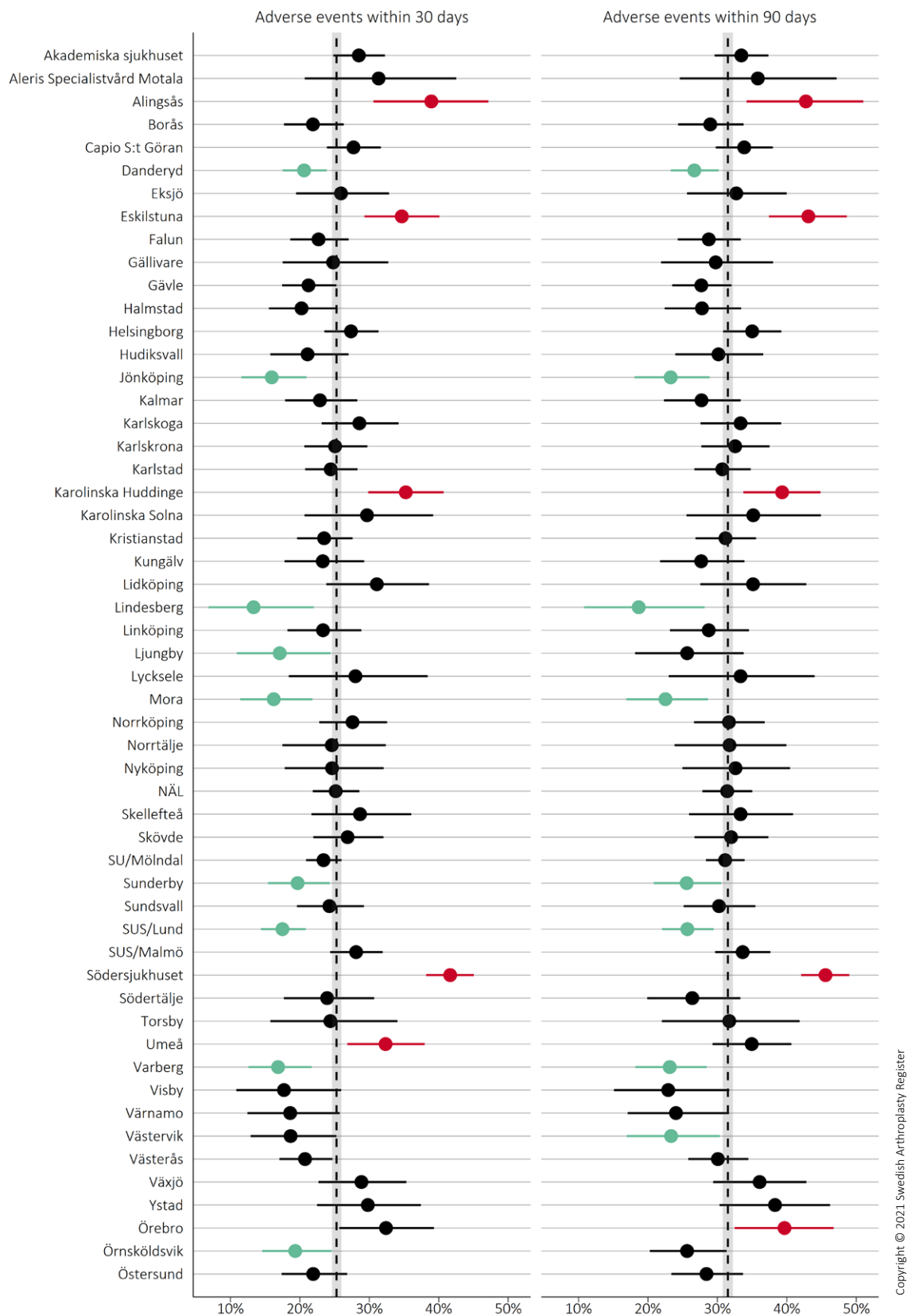
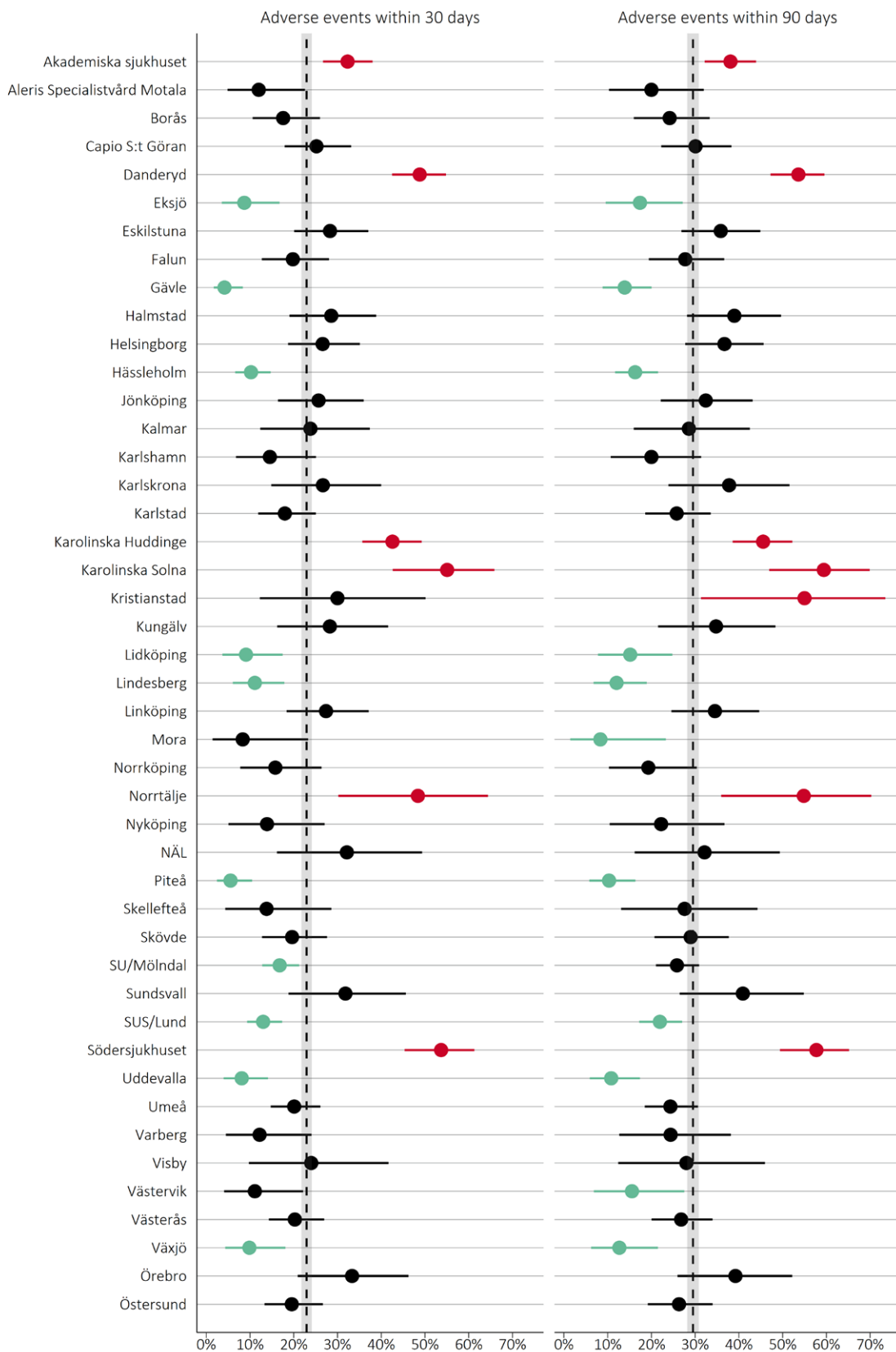


Figure 7.2.7. Adverse events per unit 2017–2019, hip replacement due to fracture.



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Figure 7.2.8. Adverse events per unit 2017–2019, first revision.

Adverse events after primary total knee replacement due to OA

Region	Number of operations	Weighted proportion (%), 30 days	Weighted proportion (%), 90 days
Country	36,487	3.2	4.4
Blekinge	689	3.6	4.2
Dalarna	949	3.6	4.5
Gotland	278	3.4	5.1
Gävleborg	1,22	1.8	2.7
Halland	2,019	2.1	3.0
Jämtland	425	5.2	6.7
Jönköping	1,569	2.6	3.5
Kalmar	1,495	3.0	5.1
Kronoberg	449	2.9	3.9
Norrbottn	960	2.6	3.2
Skåne	4,876	2.7	3.8
Stockholm	7,929	3.2	4.5
Sörmland	896	2.5	3.7
Uppsala	1,240	3.8	5.4
Värmland	1,075	2.9	4.3
Västerbotten	851	10.5	12.1
Västernorrland	918	5.4	6.3
Västmanland	662	5.2	6.0
Västra Götaland	5,363	2.7	3.9
Örebro	1,163	2.3	3.3
Östergötland	1,461	3.9	6.2

Table 7.2.2. Adverse events (weighted) within 30 and 90 days per region in primary total knee replacement due to OA.





Joint replacement surgery
aims to decreased pain, improved
function and increased
health-related quality of life.

8. Patient-reported outcome measures

Authors: Annette W-Dahl and Ola Rolfson

Patient-reported outcome measures (PROMs) are tools used to measuring the patient's own experience of their health or health-related aspects. The tools or instruments that are used to measure patient-reported outcome consists of standardised questionnaires that are answered by the patient without the interference of the interpretation by anyone else. The main goal with most of the hip and knee replacements is to decrease pain and improve function and thereby improving the individual's health-related quality of life.

Development of PROM collection for hip and knee replacements

The PROM-routine for hip replacement surgery started in 2002 as a pilot project in Norrland and the Region of Västra Götaland. Gradually, more units joined and since 2008 all units participate in the follow-up routine.

For knee replacement surgery, the PROM collection started in 2008 as a pilot project with data from Trelleborg. Then the rest of the Region of Skåne was included in the coming years. Units that wanted to participate in the project were invited and at the end of 2012 Norrköping,

Motala and Oskarshamn joined the project. Then successively more units joined and in 2020, PROMs were registered for more than 50% of the primary surgeries. The units have been able to choose if they want to collect all the PROMs included in the project or parts of it. In conjunction with the merging of the registers to the Swedish Arthroplasty Register we have harmonised our PROMs and the collection of PROMs for knee replacements will cover all units in the future, just as for the hip replacements.

Outcome measures and collection method for total hip replacement surgery

All patients, scheduled for elective total hip replacement are asked to fill in a questionnaire, including twelve questions, before the surgery. The questionnaire includes questions on comorbidity and walking ability in order to decide Charnley class, question on hip pain divided into right and left hip (five Likert boxes), and the EQ-5D instrument measuring health-related quality of life. In 2017 we started to use the new version of the EQ-5D-instrument (EQ-5D-5L) that consists of two parts; the first part consists of five general questions with five answer

options each that gives a health profile which can be translated into an index. The second part of the EQ-5D-questionnaire consists of a thermometer, EQ VAS (visual analogue scale), where the patients marks their current health condition on a scale from 0 to 100. We present the EQ-5D-index using the Swedish value set, that is the algorithm used to calculate the index. There is one index that calculate values to VAS units (from worst to best possible health 0–100) and one index that can be translated to the scale 0–1 (dead to full health) and we have chosen to present values calculated with both value sets. Since 2012, there are questions whether the patient has met a physiotherapist and has participated in the “Supported Osteoarthritis Self-Management Programme” (SOASP) preoperatively and in 2013 a question of smoking was added. The same PROM-questionnaire with the addition of one question on how satisfied the patient is with the surgery (five Likert boxes) is sent to the patient one, six and ten years after the latest surgery. The follow-up routine is managed by contact secretaries who send out the questionnaires and enter the questionnaire responses in the PROM-database. If the patients do not respond, a reminder is sent after two months. Those patients that preoperatively have given an e-mail address receives the follow-up questionnaires by e-mail.

In 2017 the PROM programme was expanded to also include reoperations. The one and the same questionnaire is used both for primary operations and reoperations. This means that the units do not have to think about which kind of surgery it is.

Two different follow-up questionnaires are used; one for those having replacement in one hip (unilateral) and one for those having replacements in both hips (bilateral). The same follow-up questionnaire is used for both primary and reoperations. In earlier annual reports (2016 and 2017) there is more detailed description of the PROM programme for hip replacements and how the programme has changed over time.

Outcome measures and collection method for knee replacement surgery

For those units participating in the PROM-routine, data is collected for all knee replacements and reoperations. The patients answer the questionnaire at the preoperative visit approximately two weeks before the surgery. The questionnaire includes questions to assess Charnley class, somewhat simplified way of assessing comorbidity. Charnley class A means unilateral knee disease, class B bilateral

knee disease and category C means multiple joint disease and/or other illness that affects the walking ability. A question on pain is measured with visual analogue scale (VAS) (0–100, best-worst scale), EQ-5D contains five questions with three response alternatives each and measuring general health status and includes EQ-VAS that measures self-rated general health. The questionnaire also includes the disease specific KOOS (Knee injury and Osteoarthritis Outcome Score) consisting of 42 questions. The KOOS consists of five subscales, pain, other symptoms, function in daily life (ADL), sport and recreation function (Sport/Rec) and knee related quality of life (QoL). Standardized answer options are given (five Likert-boxes), and each question gets a score from 0 to 4. A normalized score (100 indicating no symptoms and 0 indicating extreme symptoms) is calculated for each subscale (www.koos.nu).

One year postoperatively the same questionnaire together with the question on satisfaction with the surgery (VAS scale, 0–100, worst to best) is sent by mail. Satisfaction with the surgery is estimated one year postoperatively on a 0–100 scale (VAS) where 0 represents the highest imaginable satisfaction and 100 the worst imaginable satisfaction. The patients’ estimation is categorised as very satisfied (0–20), satisfied (21–40), moderately satisfied (41–60), not satisfied (61–80) and very dissatisfied (81–100) and is presented as the proportion of very satisfied and satisfied (0–40).

Each unit choose if they want to collect all the PROMs included in the project or parts of it. Mölndal, Capio Ortopediska huset and Capio St. Göran have chosen not to collect the disease specific KOOS, only the EQ-5D, VAS pain and satisfaction with the surgery one year postoperatively. In 2018, Helsingborg and Ängelholm decided not to collect the KOOS. During the pandemic year 2020 some units (Helsingborg, Lindesberg, Capio St. Görans and Ängelholm) have not reported any postoperative PROM data and are thereby not part of the presentation.

PROM for hip replacement 2017–2020

Table 8.1 is a compilation of all PROM responses that have been collected during the years 2017–2020 divided into preoperative, one, six and ten years postoperative for primary elective total hip replacements and preoperative and one year postoperative for reoperations. Observe that the compilation consists of cross-sectional data for patients responding during the time-period and not longitudinal data. In 95% of the cases the patients reported moderate

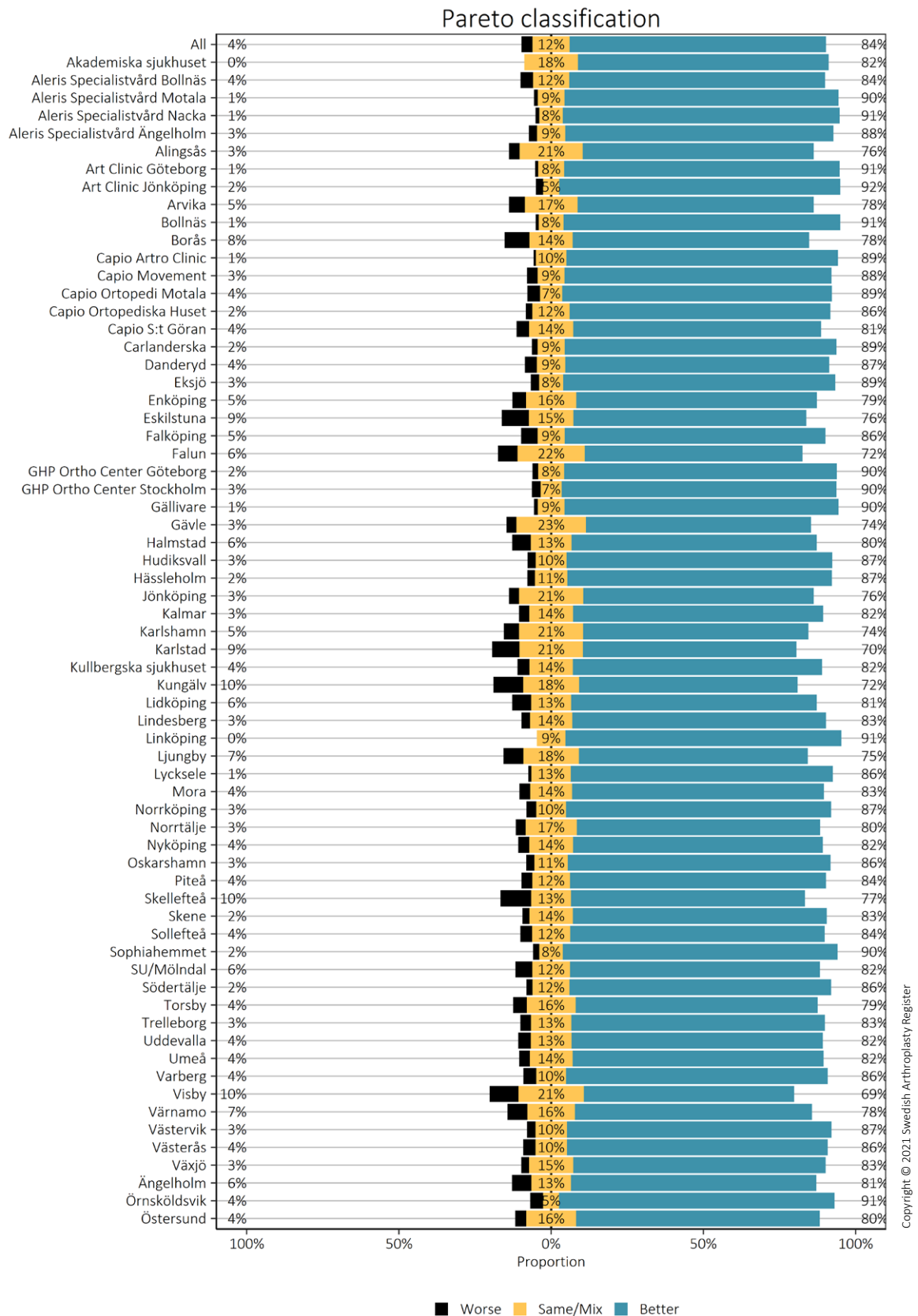


Figure 8.1. Pareto classification EQ-5D-5L, elective total hip replacement 2019.

PROM response in hip replacement 2017–2020

	Primary				Revision	
	Preoperatively		Postoperatively		Preoperatively	Postoperatively
		1 year	6 years	10 years		1 year
Number	45,261	52,268	39,897	28,297	1,335	3,555
Hip pain in the operated hip, n (%)						
None	348 (0.8)	27,978 (53.7)	22,341 (56.2)	15,266 (54.2)	47 (3.5)	1,196 (33.8)
Very mild	379 (0.8)	12,536 (24.0)	7,405 (18.6)	5,137 (18.2)	75 (5.6)	800 (22.6)
Mild	1,448 (3.2)	5,899 (11.3)	4,504 (11.3)	3,451 (12.2)	123 (9.2)	589 (16.7)
Moderate	15,957 (35.3)	4,528 (8.7)	4,259 (10.7)	3,381 (12.0)	512 (38.4)	703 (19.9)
Severe	27,015 (59.8)	1,202 (2.3)	1,255 (3.2)	942 (3.3)	575 (43.2)	248 (7.0)
Mobility, n (%)						
I have no problems in walking about	1,214 (2.7)	26,724 (51.1)	19,087 (47.8)	12,254 (43.3)	100 (7.5)	1,025 (28.8)
I have slight problems in walking about	4,911 (10.9)	13,034 (24.9)	8,850 (22.2)	6,348 (22.4)	193 (14.5)	919 (25.9)
I have moderate problems in walking about	15,973 (35.3)	8,472 (16.2)	7,452 (18.7)	5,695 (20.1)	450 (33.7)	906 (25.5)
I have severe problems in walking about	22,033 (48.7)	3,720 (7.1)	4,014 (10.1)	3,383 (12.0)	500 (37.5)	566 (15.9)
I am unable to walk about	1,130 (2.5)	318 (0.6)	494 (1.2)	617 (2.2)	92 (6.9)	139 (3.9)
Self-care, n (%)						
I have no problems washing or dressing myself	13,061 (28.9)	39,184 (75.0)	29,630 (74.3)	19,756 (69.8)	558 (41.8)	2,052 (57.8)
I have slight problems washing or dressing myself	14,447 (31.9)	9,422 (18.0)	6,388 (16.0)	4,889 (17.3)	374 (28.0)	828 (23.3)
I have moderate problems washing or dressing myself	13,566 (30.0)	3,027 (5.8)	2,875 (7.2)	2,513 (8.9)	285 (21.4)	471 (13.3)
I have severe problems washing or dressing myself	4,073 (9.0)	547 (1.0)	756 (1.9)	797 (2.8)	101 (7.6)	143 (4.0)
I am unable to wash or dress myself	114 (0.3)	88 (0.2)	248 (0.6)	342 (1.2)	16 (1.2)	58 (1.6)
Usual activities, n (%)						
I have no problems doing my usual activities	2,237 (4.9)	26,143 (50.0)	19,332 (48.5)	12,737 (45.0)	148 (11.1)	1,029 (29.0)
I have slight problems doing my usual activities	7,683 (17.0)	15,298 (29.3)	10,457 (26.2)	7,246 (25.6)	269 (20.2)	1,033 (29.1)
I have moderate problems doing my usual activities	15,206 (33.6)	7,364 (14.1)	6,294 (15.8)	4,961 (17.5)	390 (29.2)	854 (24.1)
I have severe problems doing my usual activities	16,251 (35.9)	2,826 (5.4)	2,930 (7.3)	2,470 (8.7)	365 (27.4)	434 (12.2)
I am unable to do my usual activities	3,884 (8.6)	637 (1.2)	884 (2.2)	883 (3.1)	162 (12.1)	200 (5.6)
Pain/discomfort, n (%)						
I have no pain or discomfort	99 (0.2)	19,579 (37.5)	14,171 (35.5)	9,372 (33.1)	42 (3.1)	758 (21.4)
I have slight pain or discomfort	1,351 (3.0)	18,129 (34.7)	12,064 (30.2)	8,334 (29.5)	165 (12.4)	1,196 (33.7)
I have moderate pain or discomfort	17,170 (37.9)	11,004 (21.1)	10,039 (25.2)	7,735 (27.3)	539 (40.4)	1,106 (31.2)
I have severe pain or discomfort	24,087 (53.2)	3,332 (6.4)	3,311 (8.3)	2,593 (9.2)	509 (38.1)	432 (12.2)
I have extreme pain or discomfort	2,554 (5.6)	224 (0.4)	312 (0.8)	263 (0.9)	80 (6.0)	58 (1.6)

PROM response in hip replacement 2017–2020, cont.

	Primary			Revision		
	Preoperatively		Postoperatively		Preoperatively	Postoperatively
		1 year	6 years	10 years		1 year
Anxiety/depression, n (%)						
I am not anxious or depressed	17,068 (37.7)	37,472 (71.7)	26,980 (67.6)	18,222 (64.4)	548 (41.1)	1,937 (54.5)
I am slightly anxious or depressed	17,732 (39.2)	10,920 (20.9)	9,181 (23.0)	7,049 (24.9)	524 (39.3)	1,014 (28.5)
I am moderately anxious or depressed	7,626 (16.8)	2,836 (5.4)	2,738 (6.9)	2,222 (7.9)	158 (11.9)	428 (12.0)
I am severely anxious or depressed	2,471 (5.5)	897 (1.7)	862 (2.2)	691 (2.4)	91 (6.8)	149 (4.2)
I am extremely anxious or depressed	364 (0.8)	143 (0.3)	136 (0.3)	113 (0.4)	11 (0.8)	25 (0.7)
EQ VAS, mean (SD)	57.10 (22.08)	76.66 (18.66)	72.72 (20.79)	70.44 (21.59)	57.44 (22.95)	66.92 (22.15)
Satisfaction with the surgery, n (%)						
Very dissatisfied		1,061 (2.0)	1,082 (2.7)	680 (2.4)		263 (7.4)
Dissatisfied		1,873 (3.6)	1,696 (4.3)	1,117 (4.0)		358 (10.1)
Neither satisfied nor dissatisfied		3,673 (7.1)	3,132 (7.9)	2,276 (8.1)		560 (15.9)
Satisfied		11,352 (21.9)	9,212 (23.4)	7,103 (25.4)		1,066 (30.2)
Very satisfied		33,806 (65.3)	24,284 (61.6)	16,830 (60.1)		1,284 (36.4)
EQ5D-index TTO, mean (SD)	0.65 (0.13)	0.87 (0.13)	0.85 (0.14)	0.84 (0.15)	0.69 (0.15)	0.79 (0.16)
EQ5D-index VAS, mean (SD)	47.82 (13.00)	73.96 (15.36)	71.93 (16.76)	70.13 (17.44)	51.62 (15.68)	64.50 (18.22)

Table 8.1. PROM response 2017–2020 in hip replacements.

or severe pain in the affected hip. For the one-year follow-up 78% reported no or very mild pain in the operated hip. Even if the proportion of symptom free was lower during the six-year and ten-year follow-ups, most of them seem to maintain a good hip function and health-related quality of life during the long-term follow-ups.

Considerably more one-year follow-ups than preoperative responses have been reported after hip revision. The routine of collecting preoperative PROMs for reoperations does not seem to have been established in the same good way as for primary operations. The follow-up however, seems to work satisfactorily. Part of the loss can of course be explained with many reoperations performed sub acutely and the patient therefore does not undergo the elective preoperative process. The Swedish Arthroplasty Register appeals to the units to review the routines for collecting preoperative PROMs also for the reoperations, not least since patient-reported health one year after reoperations is considerably worse compared to after the primary replacement. 18% were dissatisfied or very dissatisfied

with the surgery and 27% reported moderate or severe pain in the operated hip one year after the reoperation.

Patient-reported outcome in primary total hip replacements 2019

Table 8.2 shows data for those operated with a primary total hip replacement during 2019 and had complete pre-operative and one-year postoperative PROM-responses. 88% reported that they were satisfied or very satisfied with the surgery and 79 % reported no or very mild pain in the hip. Note that the average change in EQ VAS was 19 units on the 100 scale. Regarding the EQ-5D-dimensions it was mainly pain, mobility and usual activities that had improved.

The change in the EQ-5D-dimensions can be described by the so-called Pareto-distribution. If there is improvement in one or more of the dimensions without worsening in another dimension it is classified as “better”. If there is worsening in one or more of the dimensions

PROM response in hip replacement surgery 2019

	Primary	
	Preoperatively	One-year postoperatively
Number	13,177	13,177
Hip pain in the operated hip, n (%)		
None	101 (0.8)	7,143 (54.3)
Very mild	123 (0.9)	3,222 (24.5)
Mild	433 (3.3)	1,463 (11.1)
Moderate	4,815 (36.6)	1,024 (7.8)
Severe	7,674 (58.4)	294 (2.2)
Mobility, n (%)		
I have no problems in walking about	393 (3.0)	6,803 (51.6)
I have slight problems in walking about	1,508 (11.4)	3,289 (25.0)
I have moderate problems in walking about	4,709 (35.7)	2,073 (15.7)
I have severe problems in walking about	6,255 (47.5)	927 (7.0)
I am unable to walk about	312 (2.4)	85 (0.6)
Self-care, n (%)		
I have no problems washing or dressing myself	3,974 (30.2)	9,969 (75.7)
I have slight problems washing or dressing myself	4,234 (32.1)	2,353 (17.9)
I have moderate problems washing or dressing myself	3,805 (28.9)	711 (5.4)
I have severe problems washing or dressing myself	1,130 (8.6)	131 (1.0)
I am unable to wash or dress myself	34 (0.3)	13 (0.1)
Usual activities, n (%)		
I have no problems doing my usual activities	696 (5.3)	6,731 (51.1)
I have slight problems doing my usual activities	2,346 (17.8)	3,770 (28.6)
I have moderate problems doing my usual activities	4,483 (34.0)	1,824 (13.8)
I have severe problems doing my usual activities	4,630 (35.1)	711 (5.4)
I am unable to do my usual activities	1,022 (7.8)	141 (1.1)
Pain/discomfort, n (%)		
I have no pain or discomfort	40 (0.3)	4,918 (37.3)
I have slight pain or discomfort	436 (3.3)	4,574 (34.7)
I have moderate pain or discomfort	5,198 (39.4)	2,748 (20.9)
I have severe pain or discomfort	6,811 (51.7)	882 (6.7)
I have extreme pain or discomfort	692 (5.3)	55 (0.4)
Anxiety/depression, n (%)		
I am not anxious or depressed	4,981 (37.8)	9,443 (71.7)
I am slightly anxious or depressed	5,260 (39.9)	2,806 (21.3)
I am moderately anxious or depressed	2,166 (16.4)	695 (5.3)
I am severely anxious or depressed	677 (5.1)	202 (1.5)
I am extremely anxious or depressed	93 (0.7)	31 (0.2)

PROM response in hip replacement surgery 2019, cont.

	Primary	
	Preoperatively	One-year postoperatively
EQ VAS, mean (SD)	58.24 (21.9)	77.25 (18.4)
Satisfaction with the surgery, n (%)		
Very dissatisfied		246 (1.9)
Dissatisfied		454 (3.5)
Neither satisfied nor dissatisfied		887 (6.8)
Satisfied		2,825 (21.6)
Very satisfied		8,674 (66.3)
EQ5D-index TTO, mean (SD)	0.66 (0.13)	0.87 (0.12)
EQ5D-index VAS, mean (SD)	48.40 (13.11)	74.11 (15.20)

Table 8.2. PROM response pre- and one-year postoperatively in primary total hip replacements 2019.

without improvement in another dimension it is classified as “worse”. No change is classified as “same” and change both ways is classified as “mix”. Figure 8.1 shows the change in the EQ-5D-dimensions for the different units. Nationally, 84% improved and only 4% worsened. However, there was great variation in the country. The greatest proportion of patients that had improved was at Art Clinic Jönköping (92%) while 70% had improved in Karlstad. On several hospitals none or only 1% had worsened while 10% of the patients in Kungälv, Skellefteå and Visby had worsened. There was also great variation in the proportion of patients who had the same or mixed change (5–23%).

Physiotherapy, Supported Osteoarthritis Self-Management Programme, and smoking

Table 8.3 shows the proportion of those responding to the preoperative PROM-questionnaire and reported that they have visited a physiotherapist, participated in the “Supported Osteoarthritis Self-Management Programme” (SOASP) and are smokers respectively. The proportions are presented at unit level and refers to those having surgery due to osteoarthritis in 2019–2020 where the response rate also is shown.

What proportion use the SOASP?

In 2012 questions considering contact with physiotherapist and participation in the SOASP were added to the

preoperative PROM-questionnaire for hip replacements. The questions are: “Have you, during the hip discomfort period, been to a physiotherapist due to your hip problems?” and “Have you, during the time of hip problems, participated in the SOASP (may have been many years before the surgery for some and a little shorter time-period for others)?”. This year’s analysis, including surgical years 2019–2020, shows clear differences between the units. The proportion of patients having surgery due to osteoarthritis and had contact with a physiotherapist varies from 59% (Skövde) to 95% (Hermelinen). For the SOASP, the proportions differ from 26% (SUS Lund) to 77% (Alingsås and Norrköping). On national level, 48% of the osteoarthritis patients who responded to the questionnaire reported that they had participated in the SOASP. The proportion of those reported that they had met a physiotherapist and had participated in the SOASP has increased steadily over time. The differences between units may to some extent reflect the availability to physiotherapy and the SOASP in different regions.

During 2021 the questions considering physiotherapy and the SOASP will be deleted from the PROM-questionnaire. Instead, the Swedish Arthroplasty Register will present linked data from the Better management of patients with Osteoarthritis register (BOA-register) regarding the proportion of patients who have enrolled the SOASP. This will as well give an indication of the time interval between the SOASP and joint replacement surgery.

Physiotherapy, SOASP and smoking before the hip replacement 2019–2020

Unit	Number responses	Response rate, %	Proportion smokers, %	Proportion physiotherapist, %	Proportion SOASP, %
Akademiska sjukhuset	94	82	7.4	78	33
Aleris Specialistvård Bollnäs	256	97	3.9	75	52
Aleris Specialistvård Motala	106	83	1.9	79	65
Aleris Specialistvård Nacka	487	86	5.1	79	44
Aleris Specialistvård Ängelholm	394	74	3.2	85	45
Alingsås	245	82	4.6	86	77
Art Clinic Göteborg	235	77	4.0	92	62
Art Clinic Jönköping	345	95	1.7	90	49
Arvika	171	48	4.1	80	70
Bollnäs	275	96	4.4	72	49
Borås	104	70	6.7	73	38
Capio Artro Clinic	739	85	5.4	82	43
Capio Movement	552	73	0.9	82	39
Capio Ortopedi Motala	455	74	4.1	73	56
Capio Ortopediska Huset	1,178	93	5.4	80	46
Capio S:t Göran	589	70	4.2	74	42
Carlanderska	357	41	3.8	89	50
Danderyd	129	54	3.9	78	43
Eksjö	337	91	1.5	70	32
Enköping	569	72	3.4	81	50
Eskilstuna	74	76	4.1	72	30
Falköping	139	95	2.4	78	57
Falun	134	81	3.1	61	62
GHP Ortho Center Göteborg	394	72	2.0	87	51
GHP Ortho Center Stockholm	1,283	86	3.5	81	53
Gällivare	125	80	4.0	74	55
Gävle	137	86	6.6	71	45
Halmstad	256	79	3.9	75	30
Helsingborg	21	41	0	62	27
Hermelinen	41	91	2.4	95	46
Hudiksvall	99	88	5.2	73	47
Hässleholm	1,211	94	3.3	76	31
Jönköping	147	83	0.7	76	32
Kalmar	162	93	3.1	69	60
Karlshamn	446	94	2.5	72	56
Karlstad	99	91	2.0	71	50

Physiotherapy, SOASP and smoking before the hip replacement 2019–2020, cont.

Unit	Number responses	Response rate, %	Proportion smokers, %	Proportion physiotherapist, %	Proportion SOASP, %
Kullbergska sjukhuset	527	98	5.1	73	37
Kungälv	196	77	3.8	87	48
Lidköping	307	86	8.3	77	49
Lindesberg	680	87	4.3	79	49
Linköping	43	36	0	70	53
Ljungby	235	98	1.7	69	35
Lycksele	412	80	1.3	79	74
Mora	258	59	6.9	79	52
Norrköping	189	67	2.2	82	77
Norrtälje	197	72	7.0	75	46
Nyköping	174	86	4.6	86	52
Oskarshamn	619	95	3.1	73	44
Piteå	534	69	3.4	84	56
Skellefteå	94	49	0	80	73
Skene	214	83	5.6	83	57
Skövde	22	76	0	59	32
Sollefteå	465	97	1.7	80	67
Sophiahemmet	395	83	5.1	83	33
SU/Mölnadal	372	64	0.3	80	52
SUS/Lund	31	70	17.2	74	26
Södertälje	169	80	7.5	78	49
Torsby	174	97	3.4	74	56
Trelleborg	729	90	8.6	69	39
Uddevalla	451	91	7.8	81	64
Umeå	66	73	1.5	79	68
Varberg	312	81	2.9	81	34
Visby	213	90	2.8	62	42
Värnamo	219	93	0.5	72	27
Västervik	150	68	2.1	78	54
Västerås	454	83	3.9	76	60
Växjö	192	77	1.6	79	35
Ängelholm	283	93	3.3	76	39
Örnsköldsvik	180	85	2.8	81	56
Östersund	279	77	1.8	72	62
Country	22,29	79	3.9	78	48

Table 8.3. Physiotherapy, "Supported Osteoarthritis Self-Management Programme" (SOASP) and smoking prior hip replacement 2019–2020.

Response rate and proportion of satisfied after primary hip replacement per unit 2019

Unit	Number responses	Response rate, %	Proportion satisfied, %
Akademiska sjukhuset	44	67	86.4
Aleris Specialistvård Bollnäs	204	77	87.3
Aleris Specialistvård Motala	100	79	88
Aleris Specialistvård Nacka	197	75	92.9
Aleris Specialistvård Ängelholm	161	73	86.3
Alingsås	105	60	77.1
Art Clinic Göteborg	89	95	82
Art Clinic Jönköping	181	95	91.7
Arvika	193	85	78.2
Bollnäs	45	79	93.3
Borås	100	87	81
Capio Artro Clinic	299	80	92
Capio Movement	262	80	92
Capio Ortopedi Motala	281	88	91.8
Capio Ortopediska Huset	478	72	88.9
Capio S:t Göran	341	64	86.2
Carlanderska	329	86	91.5
Danderyd	101	68	84.2
Eksjö	168	75	88.1
Enköping	308	75	78.6
Eskilstuna	37	82	83.8
Falköping	83	80	92.8
Falun	85	73	72.9
GHP Ortho Center Göteborg	204	72	91.7
GHP Ortho Center Stockholm	526	68	92.6
Gällivare	75	87	88
Gävle	73	81	80.8
Halmstad	152	83	86.2
Hermelinen	16	67	100
Hudiksvall	69	93	91.3
Hässleholm	680	89	92.9
Jönköping	122	91	84.4
Kalmar	98	82	92.9
Karlshamn	230	80	86.1
Karlstad	59	76	76.3
Karolinska Huddinge	37	26	94.6

Response rate and proportion of satisfied after primary hip replacement per unit 2019, cont.

Unit	Number responses	Response rate, %	Proportion satisfied, %
Kullbergska sjukhuset	261	82	80.8
Kungälv	165	87	82.4
Lidköping	165	77	84.2
Lindesberg	386	78	92
Linköping	46	78	82.6
Ljungby	115	75	88.7
Lycksele	185	80	88.1
Mora	194	85	84.5
Norrköping	122	73	82
Norrtälje	136	79	76.5
Nyköping	108	85	79.6
Oskarshamn	352	93	91.5
Piteå	431	91	87.9
Skellefteå	92	94	78.3
Skene	113	74	78.8
Sollefteå	250	84	88
Sophiahemmet	161	61	96.3
SU/Möln dal	316	77	80.1
Sundsvall	8	35	87.5
SUS/Lund	17	77	82.4
Södersjukhuset	163	84	84.7
Södertälje	91	73	92.3
Torsby	94	86	80.9
Trelleborg	426	74	89.7
Uddevalla	268	82	86.6
Umeå	57	89	91.2
Varberg	177	82	93.8
Visby	99	76	77.8
Värnamo	106	77	73.6
Västervik	113	84	88.5
Västerås	269	73	86.6
Växjö	115	78	89.6
Ängelholm	158	88	82.3
Örnsköldsvik	111	84	89.2
Östersund	172	82	86
Country	12,627	79	87.3

Table 8.4. Response rate and proportion of satisfied after primary total hip replacement per unit 2019.

PROM response in primary knee replacement surgery 2019
with both pre- and one-year postoperative response

	TKR/OA		UKR/OA	
	Preoperatively	One-year postoperatively	Preoperatively	One-year postoperatively
Number	4,999	4,999	561	561
Mobility, n (%)				
I have no problems walking about	557 (11.2)	3,299 (66.2)	53 (9.5)	409 (73.2)
I have some problems walking about	4,425 (88.6)	1,682 (33.7)	504 (90.1)	149 (26.6)
I am confined to bed	10 (0.2)	4 (0.1)	2 (0.4)	1 (0.2)
Self-care, n (%)				
I have no problems with self-care	4,671 (9.6)	4,784 (95.9)	525 (93.6)	551 (98.6)
I have some problems washing or dressing myself	284 (5.7)	169 (3.4)	31 (5.5)	8 (1.4)
I am unable to wash or dress myself	38 (0.8)	37 (0.7)	5 (0.9)	0
Usual activities, n (%)				
I have no problems with performing my usual activities	2,500 (50.1)	3,989 (79.9)	235 (41.9)	473 (84.3)
I have some problems with performing my usual activities	2,208 (44.3)	937 (18.8)	299 (53.3)	83 (14.8)
I am unable to perform my usual activities	282 (5.6)	64 (1.3)	27 (4.8)	5 (0.9)
Pain/discomfort, n (%)				
I have no pain or discomfort	76 (1.5)	2,014 (40.3)	2 (0.4)	245 (43.7)
I have moderate pain or discomfort	2,208 (64.5)	2,783 (55.8)	358 (64)	294 (52.4)
I have extreme pain or discomfort	1,693 (34)	194 (3.9)	199 (35.6)	22 (3.9)
Anxiety/depression, n (%)				
I am not anxious or depressed	3,244 (65)	4,097 (82.2)	363 (65)	476 (85)
I am moderately anxious or depressed	1,625 (32.6)	823 (16.5)	188 (33.6)	78 (13.9)
I am extremely anxious or depressed	121 (2.4)	67 (1.3)	8 (1.4)	6 (1.1)
EQ5D-index TTO, mean (SD)	0,88 (0.5)	0,93 (0.05)	0,88 (0.05)	0,95 (0.05)
EQ5D-index VAS, mean (SD)	74 (7)	82 (7)	74 (7)	83 (7)
EQ-VAS, mean (SD)	64 (22)	78 (19)	65 (21)	79 (18)
VAS pain, mean (SD)	62 (21)	17 (20)	62 (21)	16 (21)
Satisfaction with the surgery, n (%)				
Very dissatisfied		187 (3.7)		15 (2.7)
Dissatisfied		188 (3.8)		19 (3.4)
Moderately satisfied		363 (7.3)		29 (5.1)
Satisfied		581 (11.6)		42 (7.5)
Very satisfied		3,680 (73.6)		456 (81.3)
Number	4,941		554	
Charnley class, n (%)				
A	1,014 (20.5)		160 (28.9)	

PROM response in primary knee replacement surgery 2019
with both pre- and one-year postoperative response, cont.

	TKR/OA		UKR/OA	
	Preoperatively	One-year postoperatively	Preoperatively	One-year postoperatively
B	1,889 (38.2)		195 (35.2)	
C	2,038 (41.3)		199 (35.9)	
Number	4,260	4,260	534	534
KOOS, mean (SD)				
Pain	41 (15)	82 (18)	42 (15)	84 (19)
Other symptom	47 (18)	78 (17)	49 (18)	82 (18)
ADL function	47 (17)	81 (18)	49 (17)	85 (17)
Sport/rec function	11 (14)	39 (27)	12 (15)	45 (28)
QoL	22 (14)	66 (23)	22 (14)	67 (23)

Table 8.5. PROM response in primary knee replacements 2019 with both pre- and one-year postoperative response.

Smoking

Smoking is a well-established risk factor for complications after most surgical interventions. Smoking cessation during 6–8 weeks before and after the surgery has been proved effective to decrease the risk of complications. In 2013 a question on smoking was added to the preoperative questionnaire. The question is simple: “Are you smoking?” with the response alternatives “Never been a smoker”, “Ex-smoker”, “Smoker, not daily” and “Daily smoker”. During 2019 and 2020 28,215 patients underwent primary hip replacement surgery due to osteoarthritis. 22,290 (79%) answered the preoperative questionnaire. Of these, 3.9% reported that they were smokers. There were large differences in the proportion of smokers between units (0 to 17%). The proportion of smokers has decreased by half a percent compared with 2018/2019.

Response rate and the proportion of satisfied with the surgery after primary total hip replacement per unit

Table 8.4 shows the response rate and the proportion of satisfied with the surgery for those operated with elective primary total replacement during 2019 and responded to the one-year follow-up. The differences between the units are large; the proportion of satisfied vary from 73 to 100%. 11 units have less than 80% of the patients satisfied with the surgery and 21 units have 90% or higher proportion of patients satisfied with the surgery. Among the large producing units, it is noted that Hässleholm, GHP Ortho

Center Stockholm and Lindesberg continue to have a large proportion of patients satisfied with the surgery.

Patient-reported outcome in primary knee replacements 2019

The outcomes are presented for primary total knee replacement (TKR) and unicompartmental knee replacements (UKR) operated due to osteoarthritis (OA) and have both preoperative and one-year postoperative responses. Table 8.5 shows the outcome for all TKRs and UKRs while the tables 8.6-11 present the outcome for all TKR and UKR per participating unit respectively. EQ-5D, satisfaction and OMERACT-OARSI responses are presented as numbers and percentages while VAS pain, EQ-VAS and KOOS are presented as mean and standard deviation (SD).

Table 8.5 shows that the majority reported some problems with their mobility before the surgery and approximately 50% reported that they had improved their mobility one year after the surgery. Only a small proportion reported problems with hygiene. Half of the patients reported that they could manage their main activities before the surgery and almost 80% one year after. Most of the patients reported some or severe pain/discomfort before the surgery and about half had reduced their pain. One third reported that they felt anxiety/depression to some or high extent before the surgery while more than 80% reported no anxiety/depression one year postoperatively.

EQ-5D-index is based on the five questions and is calculated using the newly published Swedish value-set, the algorithms that are used to calculate the index. One calculates values to VAS units (from worst to best possible health 0–100) and one can be translated to the scale dead to full health (0–1). Index is meant to be used in models for health economic calculations.

General health (EQ-VAS) and knee pain measured with VAS was reported to have improved preoperatively to one year postoperatively.

Knee-related pain, symptoms, ADL and Sport/Rec function and QoL improved at group level preoperatively to one year postoperatively. For EQ-5D, general health, VAS knee pain and the five subscales of the KOOS, the results were similar for TKR and UKR and somewhat higher proportion was categorised as satisfied or very satisfied with the surgery after UKR (89%) than after TKR (85%).

Outcomes for participating units

Observe that for units with few operations and/or low response rate, outcomes and percentages may be misleading. Outcomes for units with fewer than 5 TKRs and UKRs are not presented.

The proportion satisfied with the surgery

Table 8.6 shows that the proportion of satisfied (0–40) with the surgery in units with relatively high response frequency ($\geq 70\%$) and ≥ 70 operations vary from 73% in Norrköping to more than 92% in Oskarshamn and Västermik for TKR. The proportion who was satisfied with the surgery after UKR varies for those units that have relatively high response rate ($\geq 70\%$) and ≥ 70 operations from 90% at GHP Ortho Center Stockholm and in Piteå to 93% at Capio Ortopedi Motala. For units with fewer TKRs and UKRs and a lower response rate, the proportion of satisfied varied between 67% and 100%.

OMERACT-OARSI responders

Since a PROM mean can hide both good and bad results, Outcome Measures in Arthritis Clinical Trials – Osteoarthritis Research Society International (OMERACT-OARSI) criteria can be used to evaluate the proportion of patients that have improved preoperatively to one year postoperatively. The criteria are based on a combination of absolute and relative changes in WOMAC pain, func-

tion and total score one year after the knee replacement (Pham et al. 2004). A high responder is a patient who has improved 50% or more and has an absolute improvement of 20 points or more in WOMAC pain or function. If these criteria are not met the patient nonetheless can be classified as a low responder if the improvement is 20% or more and the absolute change is 10 points or more in two of WOMAC pain, function or total score. We convert KOOS to WOMAC and classify each patient according to the OMERACT-OARSI criteria one year after the operation as responders (high or low) or non-responders. The proportion of responders is presented as percentage.

Table 8.7 shows that 89% of the reported TKRs and UKRs in 2019 were classified as responders according to the OMERACT-OARSI criteria (of which 78% were high responders). The proportion of TKR-responders varied from 82% in Norrköping to 93% in Kalmar for units with a relatively high response rate ($\geq 70\%$) and ≥ 70 operations. The corresponding proportions for UKR was 88–89% at GHP Ortho Center Stockholm and Capio Ortopedi Motala. For units with fewer TKRs and UKRs and lower response rate, the proportion of responders varied between 84% and 100%.

General health and VAS pain – TKR

General health (EQ-VAS) in TKR due to OA and respectively unit is shown in table 8.8. Mean preoperative EQ VAS scores range from from 51 to 68, and postoperatively from 73 to 82 for units with relatively high response rate ($70\geq\%$) and ≥ 70 operations. The corresponding figures for VAS knee pain was 61–73 preoperatively and 11–27 postoperatively. For other units, general health varied from 57 to 65 preoperatively and 70 to 81 postoperatively and for VAS knee pain 59 to 75 preoperatively and 13 to 22 postoperatively.

General health and VAS pain – UKR

Table 8.9 shows general health and VAS knee pain in UKR due to OA. GHP Ortho Center Stockholm and Capio Ortopedi Motala reported 63 and 68 in general health preoperatively, respectively, and 80 postoperatively. For VAS pain these units reported 60 and 66 preoperatively, respectively, and 15 and 13 postoperatively. For other units, general health varied from 59 to 72 preoperatively and 73 to 83 postoperatively. The corresponding figures for VAS pain were 60 to 75 preoperatively and 11 to 26 postoperatively.

Satisfaction with the surgery per unit in primary knee replacement surgery 2019

Unit	TKR/OA			UKR/OA		
	Number responses	Response rate, %	Proportion satisfied, %	Number responses	Response rate, %	Proportion satisfied, %
Aleris Specialistvård Nacka	100	52.1	92	10	76.9	100
Aleris Specialistvård Ängelholm	123	86.6	87.8	42	68.9	94.7
Alingsås	85	40.8	87.1			
Art Clinic Göteborg	66	64.1	89.4	3	75	
Art Clinic Jönköping	240	94.5	90.4	9	100	77.8
Bollnäs	286	89.7	87.1	46	90.2	82.6
Borås	83	7.8	89.2			
Capio Ortopedi Motala	336	87.3	87.2	199	90	92.5
Capio Ortopediska huset	530	82.2	89.6	16	66.7	75
Eksjö	276	89.9	83.7	16	88.9	93.8
GHP Ortho Center Stockholm	399	74	91	102	72.9	90.2
Hudiksvall	44	80	95.5			
Hässleholm	723	89.3	84.9	7	20.6	85.7
Kalmar	99	95.2	90.9			
Karolinska Huddinge	56	38.6	83.9	11	55	90.9
Karolinska Solna	5	3.5	80			
Kungälv	160	88.9	81.9	37	82.2	86.5
SU/Mölndal	297	80.9	79.1	12	92.3	100
SUS/Lund	13	86.7	92.3	2	100	
Norrköping	115	87.1	73.1	9	90	66.7
Norrtälje	140	76.9	79.3	4	44.4	75
Oskarshamn	371	95.9	91.9	1	100	
Piteå	247	87	89.9	95	84.8	89.5
Södertälje	95	64.2	84.2	2	66.7	
Trelleborg	681	90	84.1	58	95.1	81
Värnamo	118	63.1	81.4			
Västervik	94	91.3	91.5			
All	5,782	82	85	681	66.8	89

Table 8.6. Satisfaction per unit in primary knee replacement.

OMERACT-OARSI responder per unit in primary knee replacement surgery 2019

Unit	TKR/OA			UKR/OA		
	Number responses	Response rate, %	Proportion satisfied, %	Number responses	Response rate, %	Proportion satisfied, %
Aleris Specialistvård Nacka	84	43.8	95.2	8	61.5	100
Aleris Specialistvård Ängelholm	100	70.4	85	33	54.1	87.9
Alingsås	75	26.8	90.7			
Art Clinic Göteborg	53	51.5	86.8	1	25	
Art Clinic Jönköping	228	89.8	91.2	9	100	88.9
Bollnäs	280	87.8	86.1	46	90.2	78.3
Borås	54	51.9	83.3			
Capio Ortopedi Motala	291	75.6	89.7	166	75.1	88.6
Eksjö	263	85.7	84.4	16	88.9	93.8
GHP Ortho Center Stockholm	373	69	91.2	97	69.3	87.6
Hudiksvall	42	76.4	92.9			
Hässleholm	697	86	85.7	6	17.6	100
Kalmar	99	95.2	92.9			
Karolinska Huddinge	33	22.8	87.9	9	45	88.9
Karolinska Solna	3	23.1				
Kungälv	152	84.4	89.5	36	80	91.7
SUS/Lund	7	46.7	100	2	100	
Norrköping	95	72	82.1	8	80	100
Norrtälje	121	66.5	83.5	4	44.4	
Oskarshamn	364	94.1	91.5	1	100	
Piteå	168	59.2	89.3	48	42.9	89.6
Södertälje	93	62.9	84.9	2	66.7	
Trelleborg	640	84.5	89.5	56	91.8	89.3
Värnamo	116	62	92.2			
Västervik	80	77.7	95			
All	4,511	74.4	88.5	548	67.4	88.5

Table 8.7. OMERACT-OARSI responder per unit in primary knee replacement 2019.

EQ-5D – TKR and UKR

The change in the EQ-5D-dimensions can be described by the so-called Pareto-distribution. If there is an improvement in one or more dimensions without a worsening in any other dimension it is classified as “better”. If there is a worsening in one or more dimensions without an improvement in any other dimension it is classified as “worse”. No change is classified as “same” and change in both directions is classified as “mix”. Figure 8.2 shows the change in the EQ-5D-dimensions for the different units. Only units with more than 20 registrations are presented. Observe that for units with few registrations, the percentages can be misleading.

EQ-5D – TKR

For all participating units 76% improved and only 6% worsened after TKR due to OA (figure 8.2). There was however large variation within the country. Art Clinic Jönköping had the largest proportion of patients that had improved (87%) among the units with relatively high response frequency (70≥%) and ≥70 operations while 72% had improved at Capio Ortopedi Motala and in Hässleholm. On several units no or only a few percent had worsened while 10% of the patients in Norrköping had worsened. There was large variation in the proportion of patients that had the same or mixed change (9–24%).

EQ-5D – UKR

For all participating units 80% improved and only 5% worsened after UKR due to OA (figure 8.3). Only two units (Capio Ortopedi Motala and GHP Ortho Center Stockholm) report relatively high response rate and ≥70 operations. At these two units 82% and 81%, respectively, had improved and 4% and 8%, respectively, had worsened.

The KOOS – TKR

Table 8.10 shows partly the results for the five scales of KOOS and partly the proportion of patients that were classified as Charnley C for TKRs operated due to OA in 2019 at each unit, respectively. The proportion of patients that were classified as Charnley C in units reporting the KOOS was 36% and varied among the units from 13% in Norrköping to 56% in Västervik.

The difference in the KOOS subscales varies, at most, preoperatively between 6 and 10 points for units with relatively high response frequency (70≥%) and ≥70 operations

and between 11 and 20 points postoperatively. Most of the units' outcomes are few points above or below the mean for all participating units. Norrköping reports in general the worst results both preoperatively and postoperatively and Kalmar reports in general the best results.

The KOOS – UKR

Table 8.11 partly shows the results for the five KOOS subscales and partly the proportion of patients classified as Charnley C for UKRs operated due to OA in 2019 at each unit respectively. The proportion of patients classified as Charnley C in units that reported the KOOS was 36% and varied among the units from 33% at Art Clinic Jönköping to 67% in Hässleholm. Only two units (GHP Ortho Center Stockholm and Capio Ortopedi Motala) that report the KOOS for UKR have relatively high response rate (70≥%) and ≥70 operations. The difference in the KOOS subscales varies between 3 and 9 points preoperatively and between 2 and 4 points postoperatively. Other units have larger variations, 8 to 18 points preoperatively and 13 to 28 points postoperatively.

Variations in outcome between units

The outcome on group level varies among comparable units, those with relatively high response rate (70≥%) and ≥70 operations. When units have relatively few operations and/or relatively large proportion of non-responders it is difficult to compare their outcome with others. Further, when we present patient-reported outcomes in this year's report we do not consider case-mix and preoperative values, that may decrease or increase differences between units.

Small differences in outcome since 2009

Since 2009, when patient-reported outcomes were presented for the first time for TKRs from Trelleborg until this year's report that considers TKRs operated in 2019 from 25 units, the variation has been small. General health one year postoperatively has varied from 75 to 78 and VAS pain from 17 to 21. The proportion of OMERTACT-OARSI-responders was 85% in 2009 and has during later years been 89%. The proportion of patients satisfied with the surgery has increased since 2009 (only patients from Trelleborg) from 81% to between 85% and 88% during later years. In the five subscales of the KOOS, the variation has been small over the years, between 1 and 4 points. These variations are small between years considering that it is different patients reporting each year.

EQVAS and VAS pain TKR/OA

Unit	Number responses	Response rate, %	EQVAS mean (SD)		VAS pain mean (SD)	
			pre	1 year	pre	1 year
Aleris Specialistvård Nacka	87	45	62 (23)	79 (18)	74 (16)	13 (17)
Aleris Specialistvård Ängelholm	96	68	64 (24)	78 (21)	73 (16)	13 (22)
Alingsås	75	36	59 (21)	72 (20)	63 (18)	21 (22)
Art Clinic Göteborg	54	52	65 (25)	78 (15)	66 (16)	18 (21)
Art Clinic Jönköping	209	82	65 (21)	79 (17)	65 (18)	14 (17)
Bollnäs	275	86	60 (22)	78 (19)	65 (16)	17 (21)
Borås	52	50	60 (22)	72 (19)	65 (21)	14 (20)
Capio Ortopedi Motala	295	77	60 (22)	75 (19)	70 (16)	18 (21)
Capio Ortopediska huset	488	76	68 (21)	82 (15)	61 (18)	15 (18)
Eksjö	240	78	65 (20)	75 (19)	61 (17)	21 (19)
GHP Ortho Center Stockholm	371	69	65 (22)	81 (16)	64 (19)	13 (19)
Hudiksvall	42	76	57 (21)	77 (19)	64 (20)	14 (17)
Hässleholm	683	84	67 (21)	78 (19)	61 (18)	18 (19)
Kalmar	99	95	61 (21)	79 (18)	65 (17)	11 (18)
Karolinska Huddinge	38	26	60 (27)	69 (21)	69 (17)	18 (20)
Karolinska Solna	3	23				
Kungälv	146	81	61 (25)	75 (19)	68 (17)	16 (19)
SU/Mölndal	239	66	61 (25)	70 (23)	64 (20)	22 (24)
SUS/Lund	6	40	68 (22)	72 (21)	75 (17)	21 (22)
Norrköping	97	73	60 (23)	73 (20)	71 (16)	27 (24)
Norrtälje	107	59	64 (20)	76 (18)	62 (16)	18 (21)
Oskarshamn	337	87	65 (22)	80 (17)	63 (18)	13 (17)
Piteå	169	60	61 (23)	76 (20)	68 (17)	17 (21)
Södertälje	87	59	64 (23)	74 (20)	70 (16)	22 (26)
Trelleborg	612	81	68 (22)	77 (20)	65 (18)	19 (20)
Värnamo	105	56	61 (23)	78 (20)	59 (22)	15 (21)
Västervik	73	71	51 (24)	79 (15)	69 (16)	16 (16)
All	5,085	72	64 (22)	78 (19)	64 (19)	17 (20)

Table 8.8. EQ-VAS and VAS pain per unit in primary TKR due to osteoarthritis 2019.

EQVAS and VAS pain UKR/OA

Unit	Number responses	Response rate, %	EQVAS mean (SD)		VAS pain mean (SD)	
			pre	1 year	pre	1 year
Aleris Specialistvård Nacka	9	69	68 (17)	82 (15)	60 (18)	18 (22)
Aleris Specialistvård Ängelholm	32	52	65 (21)	85 (13)	75 (17)	16 (22)
Art Clinic Göteborg	1	25	75	80	64	20
Art Clinic Jönköping	9	100	70 (11)	73 (18)	61 (12)	14 (20)
Bollnäs	45	88	62 (24)	74 (24)	65 (19)	19 (21)
Capio Ortopedi Motala	166	75	63 (22)	80 (17)	66 (16)	13 (19)
Capio Ortopediska huset	15	63	63 (22)	79 (14)	69 (16)	20 (22)
Eksjö	16	89	67 (17)	82 (13)	58 (15)	14 (18)
GHP Ortho Center Stockholm	95	68	68 (18)	80 (17)	60 (15)	15 (23)
Hässleholm	6	18	72 (19)	78 (21)	70 (13)	26 (21)
Karolinska Huddinge	10	50	58 (18)	80 (18)	69 (14)	11 (20)
Kungälv	35	78	59 (23)	83 (17)	72 (14)	15 (21)
SU/Mölnadal	12	92	63 (19)	82 (15)	64 (15)	12 (12)
SUS/Lund	2	100	80	88 (11)	60	25 (7)
Norrköping	8	80	64 (23)	79 (19)	73 (9)	23 (28)
Norrtälje	4	44	66 (26)	73 (23)	59 (15)	35 (20)
Oskarshamn	1	100	89	96	20	20
Piteå	48	43	64 (21)	74 (22)	68 (16)	17 (25)
Södertälje	2	67	33 (25)	65 (21)	48 (60)	28 (25)
Trelleborg	56	92	70 (23)	81 (16)	64 (15)	21 (21)
All	572	67	65 (17)	79 (18)	66 (17)	16 (21)

Table 8.9. KOOS per unit in primary TKR due to osteoarthritis 2019.

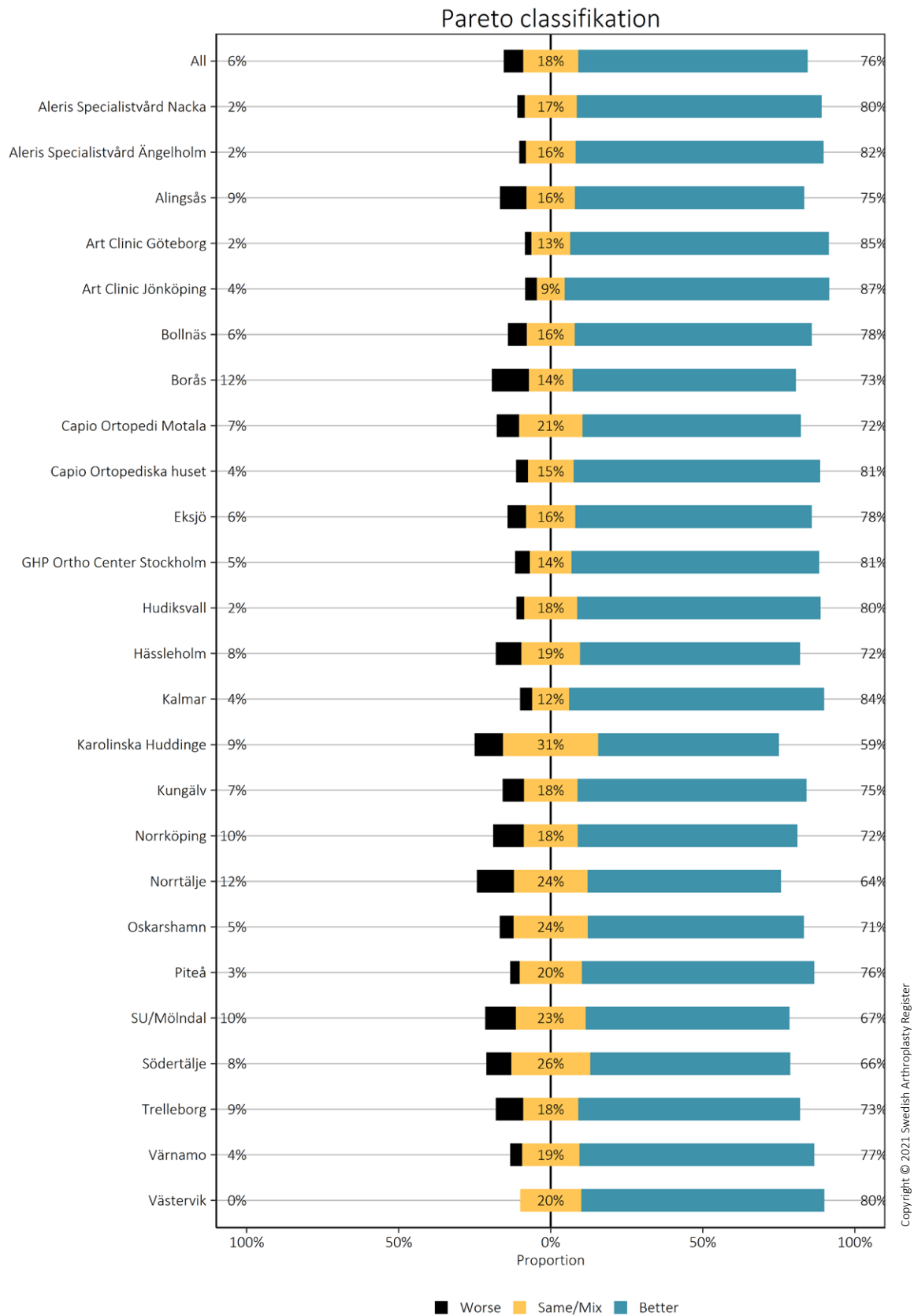


Figure 8.2. Pareto classification EQ-5D-3L, TKR/OA 2019.

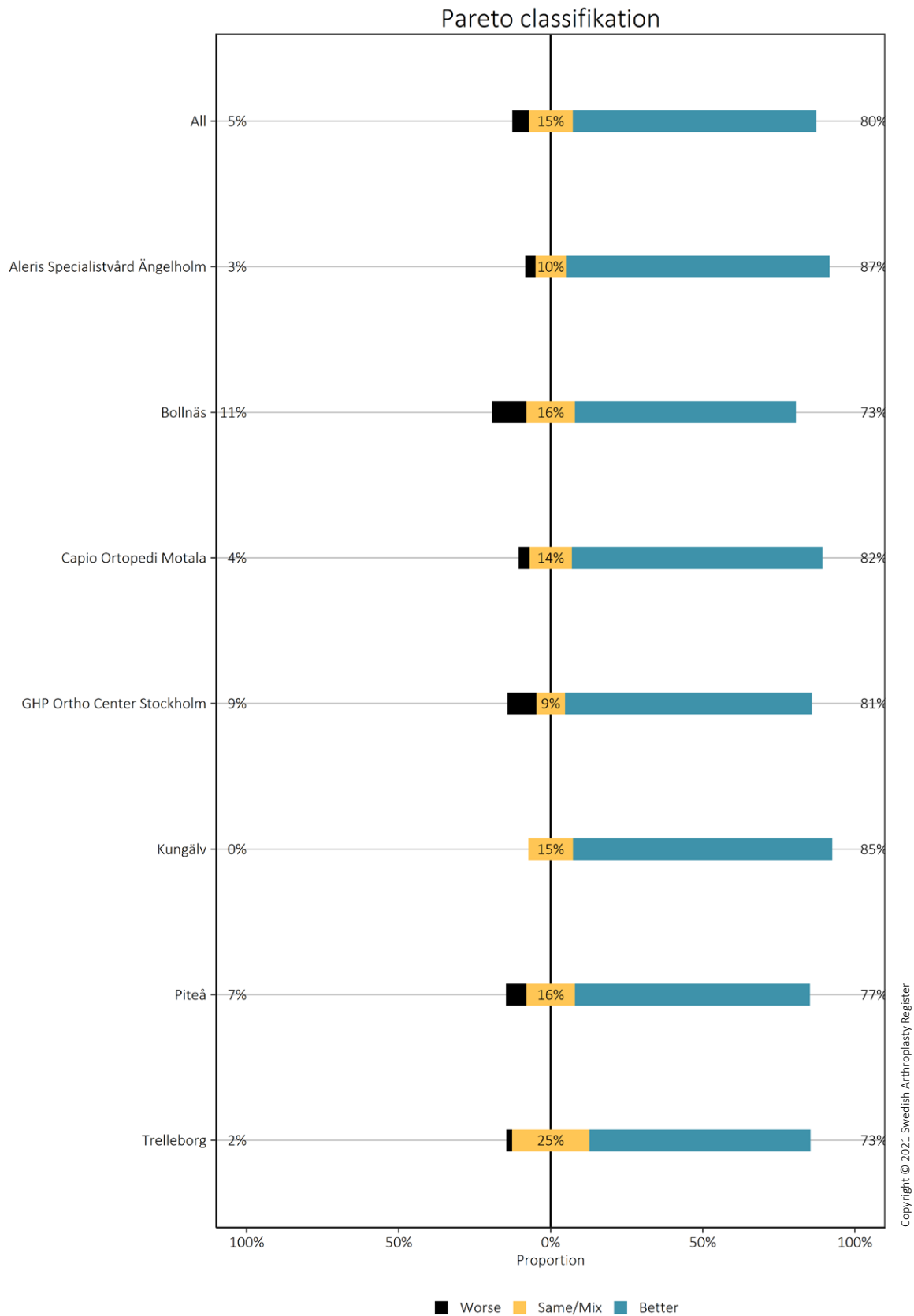


Figure 8.3. Pareto classification EQ-5D-3L, UKR/OA 2019.

KOOS per unit TKR/OA 2019

Unit	Number responses	Response rate, %	Proportion Charnley C, %	Pain mean (SD)		Other symptoms mean (SD)		ADL mean (SD)		Sport/rec mean (SD)		QoL mean (SD)	
				pre	1 year	pre	1 year	pre	1 year	pre	1 year	pre	1 year
Aleris Specialistvård Nacka	85	44.2	31.7	38 (16)	87 (14)	41 (18)	82 (15)	47 (17)	86 (15)	10 (14)	44 (30)	22 (12)	73 (21)
Aleris Specialistvård Ängelholm	100	70.4	41.8	37 (15)	78 (20)	41 (17)	73 (18)	43 (18)	78 (21)	9 (13)	40 (27)	19 (14)	63 (25)
Alingsås	74	35.6	47.2	42 (15)	79 (19)	47 (17)	78 (16)	48 (15)	78 (18)	10 (11)	31 (25)	23 (14)	62 (22)
Art Clinic Göteborg	53	51.5	32.7	42 (15)	83 (17)	49 (17)	78 (16)	48 (16)	83 (16)	11 (13)	41 (29)	22 (14)	66 (24)
Art Clinic Jönköping	227	89.4	32.6	41 (15)	83 (18)	47 (17)	77 (17)	48 (16)	82 (18)	11 (15)	43 (28)	21 (14)	67 (23)
Bollnäs	282	88.4	39.3	41 (14)	82 (19)	47 (17)	78 (16)	48 (16)	81 (18)	14 (16)	43 (28)	23 (13)	66 (25)
Borås	55	52.9	49.1	40 (16)	78 (23)	52 (18)	75 (21)	47 (16)	76 (23)	11 (13)	35 (28)	21 (15)	61 (25)
Capio Ortopedi Motala	291	75.6	45.1	38 (15)	81 (19)	45 (17)	79 (16)	43 (15)	80 (19)	8 (13)	37 (27)	20 (13)	63 (24)
Eksjö	264	86	45.5	42 (15)	80 (19)	49 (18)	77 (17)	48 (15)	78 (19)	14 (15)	39 (27)	25 (14)	66 (24)
GHP Ortho Center Stockholm	373	69.2	33.8	44 (17)	86 (15)	46 (17)	82 (14)	51 (17)	86 (15)	13 (15)	43 (25)	23 (14)	68 (21)
Hudiksvall	42	76.4	38.1	38 (16)	84 (15)	39 (17)	75 (16)	44 (18)	82 (18)	11 (17)	43 (26)	17 (14)	65 (24)
Hässleholm	697	86	41	42 (15)	81 (17)	48 (18)	76 (16)	48 (16)	79 (17)	12 (14)	35 (27)	23 (14)	65 (22)
Kalmar	99	95.2	40.4	43 (14)	88 (15)	51 (16)	82 (18)	50 (14)	85 (16)	12 (15)	40 (25)	24 (14)	72 (21)
Karolinska Huddinge	33	22.8	51.5	42 (15)	77 (23)	46 (14)	77 (20)	46 (16)	74 (21)	9 (12)	38 (29)	20 (12)	65 (23)
Karolinska Solna	3	23.1											
Kungälv	152	84.4	52.7	41 (16)	81 (18)	46 (17)	78 (16)	46 (16)	78 (19)	11 (13)	34 (26)	21 (12)	63 (21)
SUS/Lund	7	46.7	57.1	29 (17)	72 821)	25 (9)	69 (17)	26 (11)	59 (29)	2 (3)	21 (22)	13 (8)	53 (27)
Norrköping	95	72	45.2	35 (15)	71 822)	43 (18)	71 (20)	40 (16)	69 (21)	8 (15)	25 (25)	18 (12)	53 (24)
Norrtälje	122	67	37.3	44 815)	83 (17)	51 (19)	75 (17)	51 (16)	80 (18)	14 (15)	41 (27)	25 (14)	64 (23)
Oskarshamn	363	93.8	46.4	43 (14)	86 (16)	50 (17)	82 (15)	48 (16)	84 (16)	13 (15)	45 (29)	23 (13)	70 (22)
Piteå	168	59.2	49.4	39 (15)	84 (17)	43 (16)	80 (17)	43 (15)	81 (18)	9 (15)	46 (29)	20 (13)	67 (23)
Södertälje	93	62.8	50	40 (15)	78 (21)	46 (18)	74 (18)	44 (17)	76 (22)	12 (14)	40 (29)	22 (13)	62 (26)
Trelleborg	640	84.5	45.8	41 (16)	80 (19)	48 (18)	77 (17)	47 (18)	77 (20)	11 (14)	35 (27)	23 (14)	65 (24)
Värnamo	117	62.6	49.6	38 (16)	81 820)	46 (18)	79 (17)	43 (17)	83 (18)	8 (12)	39 (27)	22 (14)	67 (25)
Västervik	80	77.7	56.4	37 (16)	85 (17)	42 (18)	80 (15)	43 (15)	83 (18)	8 (9)	41 (29)	21 (12)	69 (24)
All	4,515	74.6	35.7	41 (16)	82 (18)	47 (18)	78 (17)	47 (17)	80 (19)	11 (14)	39 (27)	22 (14)	66 (23)

Table 8.10. KOOS per unit in TKR due to osteoarthritis 2019.

KOOS per unit UKR/OA 2019

Unit	Number responses	Response rate, %	Proportion Charnley C, %	Pain mean (SD)		Other symptoms mean (SD)		ADL mean (SD)		Sport/rec mean (SD)		QoL mean (SD)	
				pre	1 year	pre	1 year	pre	1 year	pre	1 year	pre	1 year
Aleris Specialistvård Nacka	9	69.2	31.7	46 (17)	82 (19)	53 (15)	86 (14)	47 (8)	82 (16)	18 (17)	37 (24)	24 (17)	62 (29)
Aleris Specialistvård Ängelholm	34	55.7	47.1	42 (16)	81 (21)	48 (17)	77 (21)	45 (14)	83 (18)	14 (11)	48 (27)	21 (13)	66 (24)
Art Clinic Göteborg	1	25											
Art Clinic Jönköping	9	100	22.2	36 (15)	83 (18)	39 (16)	72 (19)	55 (9)	86 (15)	12 (13)	40 (30)	22 (16)	60 (21)
Bollnäs	46	90.2	32.6	42 (16)	80 (20)	48 (20)	79 (19)	50 (18)	83 (19)	13 (14)	53 (32)	22 (14)	64 (29)
Capio Ortopedi Motala	166	75.1	42.9	40 (15)	85 (18)	46 (17)	82 (18)	46 (17)	85 (17)	9 (13)	41 (27)	21 (13)	68 (22)
Eksjö	16	88.9	31.3	42 (15)	87 (18)	49 (13)	79 (20)	55 (17)	88 (17)	15 (13)	51 (25)	24 (14)	66 (23)
GHP Ortho Center Stockholm	97	69.3	29.2	47 (15)	86 (16)	55 (19)	85 (14)	54 (17)	87 (14)	15 (17)	45 (27)	25 (14)	66 (23)
Hässleholm	6	26.5	66.7	37 (8)	67 (21)	40 (13)	58 (22)	44 (10)	75 (16)	3 (4)	44 (30)	18 (14)	51 (13)
Karolinska Huddinge	9	45	44.4	49 (17)	91 (16)	57 (15)	86 (16)	54 (19)	88 (16)	8 (12)	58 (39)	24 (13)	77 (25)
Kungälv	35	77.8	35.3	40 (14)	85 (15)	44 (15)	85 (14)	46 (13)	86 (15)	14 (22)	46 (29)	22 (14)	72 (21)
SUS/Lund	2	100											
Norrköping	8	80	12.5	38 (9)	80 (23)	52 (13)	76 (25)	46 (8)	78 (21)	6 (4)	43 (40)	22 (16)	63 (28)
Norrtälje	4	50											
Oskarshamn	1	100											
Piteå	48	42.9	41.7	38 (13)	85 (20)	46 (20)	84 (19)	45 (19)	84 (21)	13 (15)	50 (29)	17 (13)	72 (25)
Södertälje	2	66.7											
Trelleborg	56	91.8	25	46 (16)	81 (22)	57 (18)	81 (17)	52 (17)	86 (15)	14 (14)	49 (28)	25 (15)	68 (23)
All	549	67.4	36.5	42 (15)	84 (19)	49 (18)	82 (18)	49 (17)	85 (17)	12 (15)	46 (28)	22 (14)	67 (24)

Table 8.11. KOOS per unit in UKR due to osteoarthritis 2019.

The Swedish Arthroplasty Register and clinical research

Author: Ola Rolfson

The government together with the Swedish Association of Local Authorities and Regions have made an agreement about financing of Swedish national quality registers. The vision is that the registers should be an integrated part in a national system for the centralised knowledge management with follow-up of Swedish healthcare. The registers are to contribute to learning and improvement, quality development, saving lives, achieve equal health, resource-effective healthcare, improvement work among healthcare providers, and as a source of clinical research, including cooperation with the life science-sector. Apart from financing costs for managing the registries, the allocations from the Swedish Association of Local Authorities and Regions and the government go to the two first missions. The idea is that register-based research should be financed by other means.

What is research and what is operational analysis?

The line between what is deemed clinical research and operational analysis or improvement work is blurry. All register analysis that has as an aim to feedback results to improve healthcare activities rests on scientific methods. Within the register we make aimed in-depth analyses, validation studies and co-linking of data with other health data registers that are carried out according to established research methods. There is continuous work along scientific principles in improving and developing the methods that are used in the register work. Even though the central allocations are not meant for research, the Swedish Association of Local Authorities and Regions regularly evaluate the registers' research activities. A high research activity is a criterion to give a register the highest level of certification.

55 dissertations from the Swedish Arthroplasty Register

When all dissertations that are wholly or in part based on data from the Swedish hip and knee arthroplasty registers

are taken together it can be said that we have had an impressive research production since we started in the mid-1970s. The sum of all research publications from the registers amounts to 384 and only during the latest five-year period we have published 134 articles.

Within the Swedish Arthroplasty Register we will continue our strategic work to maintain the research infrastructure with the aim of maintaining a high research activity. It is especially gratifying that the PhD-students that currently have ongoing dissertation work with data from the Swedish Arthroplasty Register represent eight Swedish universities (Uppsala University, Lund University, University of Gothenburg, Umeå University, Linköping University, Karolinska Institutet, Örebro University and the Linnaeus University).

Defences of dissertations in 2020

During 2020 as many as nine dissertations that contain data from the hip and/or knee arthroplasty registers and with supervision of register co-workers were defended.

2020-10-09 Diagnosis and management of periprosthetic joint infections. *Karin Svensson*

2020-09-18 Predicting mortality by comorbidity for patients with hip arthroplasty: Prospective observational register studies of a nationwide Swedish cohort. *Erik Bülow*

2020-09-11 Pharmacological and surgical interventions in obese knee OA patients. *Anders Overgaard*

2020-09-11 Preoperative psychological distress and postoperative contentment after primary total knee replacement. *Aamir Mahdi*

2020-06-11 Total hip arthroplasty, osteolysis and cardiovascular disease in patients with osteoarthritis of the hip. *Agata Rysinska*

2020-05-08 Dislocation after hip fracture related arthroplasty – Incidence, risk factors and prevention. *Ammar Jobory*

2020-05-08 Fast-track programs in total hip and knee replacement at Swedish hospitals – influences on safety, outcome and patients' experiences. *Urban Berg*

2020-03-27 Outcomes following primary total hip arthroplasty – with focus on the surgeon & surgeons' perceptions about feedback. *Per Jolbäck*

2020-03-20 Periprosthetic femoral fracture after total hip replacement. Incidence, risk factors, and treatment. *Georgios Chatziagorou*

- Regardless of if exposure or outcome is studied, the register study enables, due to its size and long follow-up time, that events that occur seldom can be studied.

- The registration of an individual in a quality register does not require informed consent. This means that it is easier to collect data and that the gathering of data can be carried out to a low cost.

- The continuous longitudinal gathering of data enables analyses of changes in patient demography, treatment, adherence to recommendations, and results over time.

What is needed to use register data for research purposes?

All register-based research with individual data requires approval of the Swedish Ethical Review Authority (EPM). All information in the register is viewed as public but is secrecy-protected according to the Public Access to Information and Secrecy Act (Offentlighet- och sekretesslagen). The Västra Götaland Region is the central data controlling responsible authority (CPUA) and assesses all requests for data acquisition for secrecy. We use special forms for the request of data that can be downloaded from the website of Registercentrum (<https://slr.registercentrum.se/forskning>). Rules and regulations around register research are available at the website of the Swedish Association of Local Authorities and Regions' pages on quality registers (<https://skr.se/kvalitetsregister/forskning.43894.html>).

Why is observational research needed?

Register studies and randomised clinical trials (RCTs) complement each other. Research within joint replacement surgery demands a long follow-up time and many patients. Some important outcome parameters (reoperations and mortality) happen relatively seldom. This makes register studies especially well-suited for research in joint replacement surgery. Register studies have special advantages that can be highlighted in this context:

- Register studies represent results in practice. This means that the result has a high degree of generalisability. A register study gives a just picture of how a certain treatment works in routine healthcare in the normal population.



If you want to discuss a research project, we recommend that you contact the register management. The register management is open for ideas, proposals and discussion on cooperation in new register studies. The databases of the register are also well-suited for research work during residency (ST) and writing of master's theses or other theses. During the last five years several such projects have been undertaken and many of them are summed-up in the annual reports.

Research meeting

Since 2012, we have arranged a two-days research meeting. All affiliated doctoral students, supervisors and others who are working with register studies in muscular skeletal disorders and injuries are invited. Both general and specific research questions are discussed in work-shops. The meeting 2021 was organized as a virtual meeting and had about 50 participants.

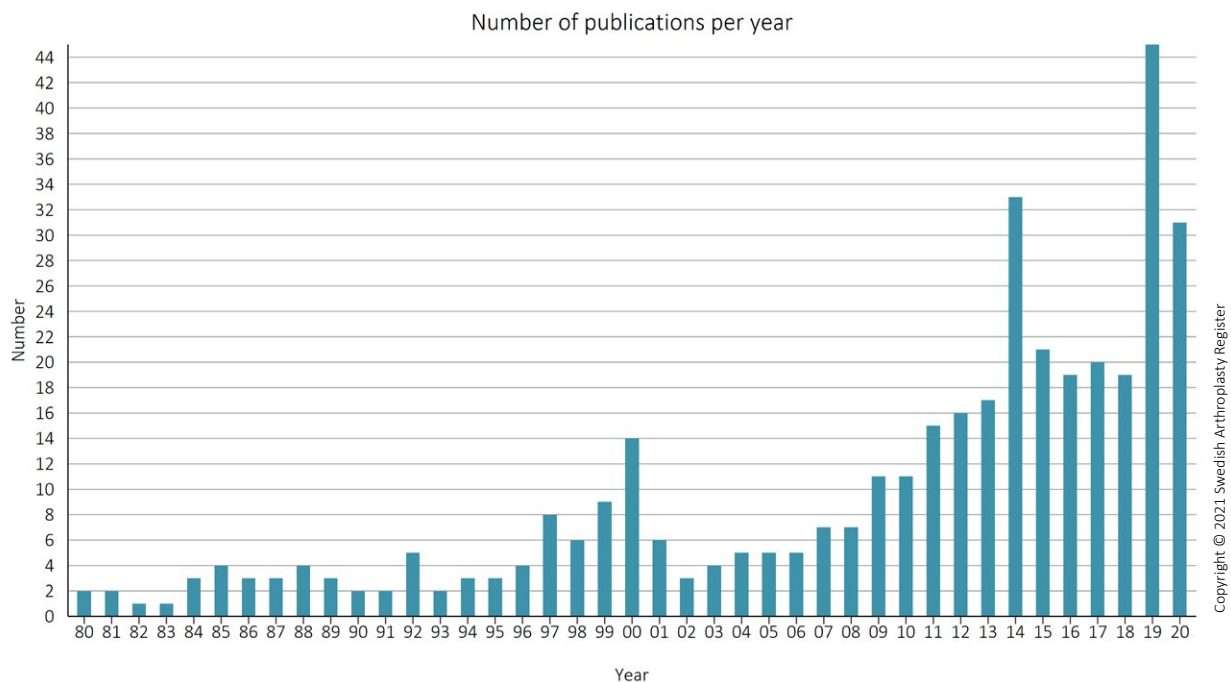
Many researchers contribute to the register activities

Within the register management team and the steering committee there are senior researchers who are supervisors and co-supervisors for PhD-students that are affiliated to

the register. In addition, there are other researchers who, in collaboration with the register management team, conduct research within the area; on-going studies of different implants and type of fixation, epidemiology, health-economics, equal care, hip fractures and prosthesis surgery, periprosthetic fractures, revision surgery, statistical methodology, infection and patient reported outcome after joint replacement.

International research collaborations

The register has an intensive research collaboration within the NARA (Nordic Arthroplasty Register Association), a register collaboration between Finland, Norway, Denmark and Sweden since 2007 and a common database is created annually. The NARA group has now published close to 40 scientific papers and further manuscripts are in progress. The NARA-data are available for Swedish PhD-students. The register has research collaborations with about ten other arthroplasty registers in the world through the International Society of Arthroplasty Registers (ISAR).



Scientific production of publications with data from the Swedish Arthroplasty Register over the years.

International work

Author: Ola Rolfson

The Swedish Arthroplasty Register continues to collaborate with other international registers. For example, we have surveyed the use of and the outcome after hip replacement where metal-on-metal articulations have been used in a cooperation with ten other European registers, within the framework of Network of Orthopaedic Registries of Europe (NORE). In total, 54,434 resurfacing hips and 58,498 stemmed hip replacements with large metal-on-metal articulations were included. The study showed that the risk of revision five years after the surgery was more than twice with metal-on-metal articulations compared with traditional replacements. Furthermore, we found that the follow-up routine after insertion of resurfacing implants differed marginally between European countries. Control of cobalt and chromium ions and MR was the most common recommendation.

Within the framework of a PhD-thesis we are studying revision after total knee arthroplasty by using information from three arthroplasty registers, Sweden, Australia and Kaiser Permanente in the US.

The Swedish Arthroplasty Register participates in a Nordic collaboration within the framework of NARA (Nordic Arthroplasty Register Association) where a common de-identified database has been developed in order to perform analyses of combined hip and knee replacement data from Denmark, Norway, Sweden and Finland. The register also has projects in cooperation with AOANJRR (Australian Orthopaedic Association National Joint Re-

placement Register). Together with other registries we also cooperate within other international organisations such as ISAR (International Society of Arthroplasty Registries) and OECD (Organisation for Economic Co-operation and Development) and with researchers in Sweden and in other countries.

The Swedish Arthroplasty Register has been represented at several international meetings in 2020 which among others were organised by The European Federation of National Associations of Orthopaedics and Traumatology, European Hip Society and the International Society of Arthroplasty Registries. All meetings have been conducted digitally due to the pandemic. Researchers and register co-workers connected to the Swedish Arthroplasty Register were represented at these meetings and contributed with scientific presentations.

In addition, such collaborative projects lead to interesting results, they give the participants insight into each other's methods for registration, selection, analyses and reporting. In turn this also hopefully means that the registers approaching so that will be easier to compare the individual countries outcome in scientific papers and reports in the future.

We believe that the growing international cooperation in recent years has had a positive impact both on research, activities and not least for patients.

Publications 2019–2021

Scientific articles published from 1 January 2019 to 31 August 2021, which have used data from the Swedish Arthroplasty Register or its predecessors, are listed below. For a complete list of publications, please refer to the Register's website.

2021 (until 31 August)

Teni FS, Rolfson O, Devlin N, Parkin D, Naclér E, Burström K; Swedish Quality Register (SWEQR) Study Group. Variations in Patients' Overall Assessment of Their Health Across and Within Disease Groups Using the EQ-5D Questionnaire: Protocol for a Longitudinal Study in the Swedish National Quality Registers. *JMIR Res Protoc*. 2021 Aug 27;10(8):e27669.

Wadström MG, Hailer NP, Hailer YD. No increased mortality after total hip arthroplasty in patients with a history of pediatric hip disease: a matched, population-based cohort study on 4,043 patients. *Acta Orthop*. 2021 Aug 16:1-5.

Lacny S, Faris P, Bohm E, Woodhouse LJ, Robertsson O, Marshall DA. Competing Risks Methods Are Recommended for Estimating the Cumulative Incidence of Revision Arthroplasty for Health Care Planning Purposes. *Orthopedics*. 2021 Jul-Aug;44(4):e549-e555.

Silman AJ, Combescure C, Ferguson RJ, Graves SE, Paxton EW, Frampton C, Furnes O, Fenstad AM, Hooper G, Garland A, Spekenbrink-Spooren A, Wilkinson JM, Mäkelä K, Lübbeke A, Rolfson O. International variation in distribution of ASA class in patients undergoing total hip arthroplasty and its influence on mortality: data from an international consortium of arthroplasty registries. *Acta Orthop*. 2021 Jun;92(3):304-310.

Bohm ER, Kirby S, Trepman E, Hallstrom BR, Rolfson O, Wilkinson JM, Sayers A, Overgaard S, Lyman S, Franklin PD, Dunn J, Denissen G, W-Dahl A, Ingelsrud LH, Navarro RA. Collection and Reporting of Patient-reported Outcome Measures in Arthroplasty Registries: Multinational Survey and Recommendations. *Clin Orthop Relat Res*. 2021 Jul 21.

Wildeman P, Rolfson O, Söderquist B, Wretenberg P, Lindgren V. What Are the Long-term Outcomes of Mortality, Quality of Life, and Hip Function after Prosthetic Joint Infection of the Hip? A 10-year Follow-up from Sweden. *Clin Orthop Relat Res*. 2021 May 31.

Goude F, Kittelsen SAC, Malchau H, Mohaddes M, Rehnberg C. The effects of competition and bundled payment on patient reported outcome measures after hip replacement surgery. *BMC Health Serv Res*. 2021 Apr 26;21(1):387.

Berg U, W-Dahl A, Nilsson A, Naclér E, Sundberg M, Rolfson O. Fast-Track Programs in Total Hip and Knee Replacement at Swedish Hospitals-Influence on 2-Year Risk of Revision and Mortality. *J Clin Med*. 2021 Apr 14;10(8):1680.

Jobory A, Kärrholm J, Hansson S, Åkesson K, Rogmark C. Dislocation of hemiarthroplasty after hip fracture is common and the risk is increased with posterior approach: result from a national cohort of 25,678 individuals in the Swedish Hip Arthroplasty Register. *Acta Orthop*. 2021 Apr 6:1-6.

Garland A, Bülow E, Lenguerrand E, Blom A, Wilkinson M, Sayers A, Rolfson O, Hailer NP. Prediction of 90-day mortality after total hip arthroplasty. *Bone Joint J*. 2021 Mar;103-B(3):469-478.

Silman AJ, Combescure C, Ferguson RJ, Graves SE, Paxton EW, Frampton C, Furnes O, Fenstad AM, Hooper G, Garland A, Spekenbrink-Spooren A, Wilkinson JM, Mäkelä K, Lübbeke A, Rolfson O. International variation in distribution of ASA class in patients undergoing total hip arthroplasty and its influence on mortality: data from an international consortium of arthroplasty registries. *Acta Orthop*. 2021 Mar 1:1-7.

Lindman I, Nätman J, Öhlin A, Svensson Malchau K, Karlsson L, Mohaddes M, Rolfson O, Sansone M. Prior hip arthroscopy does not affect 1-year patient-reported outcomes following total hip arthroplasty: a register-based matched case-control study of 675 patients. *Acta Orthop*. 2021 Feb 10:1-5.

Ighani Arani P, Wretenberg P, Ottosson J, Robertsson O, W-Dahl A. Bariatric surgery prior to total knee arthroplasty is not associated with lower risk of revision: a register-based study of 441 patients. *Acta Orthop*. 2021 Feb;92(1):97-10.

2020

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Dissertations

The following theses with data from the Swedish Arthroplasty Register or its predecessors were defended in 2020. For a complete list of dissertations, please refer to the Register's website.

2020-10-09

Diagnosis and management of periprosthetic joint infections. *Karin Svensson, University of Gothenburg*.

2020-09-18

Predicting mortality by comorbidity for patients with hip arthroplasty: Prospective observational register studies of a nationwide Swedish cohort. *Erik Bülow, University of Gothenburg*

2020-09-11

Preoperative psychological distress and postoperative contentment after primary total knee replacement. *Aamir Mahdi A, Örebro University*.

2020-09-11

Pharmacological and surgical interventions in obese knee OA patients. *Anders Overgaard, University of Copenhagen*.

2020-06-11

Total hip arthroplasty, osteolysis and cardiovascular disease in patients with osteoarthritis of the hip. *Agata Rysinska, Karolinska institutet*

2020-05-08

Dislocation after hip fracture related arthroplasty – Incidence, risk factors and prevention. *Ammar Jobory, Lund University*

2020-05-08

Fast-track programs in total hip and knee replacement at Swedish hospitals – influences on safety, outcome and patients' experiences. *Urban Berg, University of Gothenburg*.

2020-03-27

Outcomes following primary total hip arthroplasty. With focus on the surgeon & surgeons' perceptions about feedback. *Per Jolbäck, University of Gothenburg*

2020-03-20

Periprosthetic femoral fracture after total hip replacement. Incidence, risk factors, and treatment. *Georgios Chatziagorou, University of Gothenburg*.

Thank you to contact secretaries and contact surgeons

We would like to take the opportunity to acknowledge and thank our contact secretaries and contact surgeons all around Sweden for your fine work and commitment during the past year.

Akademiska sjukhuset

Andreas Bruggeman
Caroline Sköld
Mari Nilsson

Aleris Specialistvård

Nacka

Mikael Bouleu
Jennie Henriksson Lantto
Ulrica Lundholm

Aleris Specialistvård

Ängelholm

Herbert Franzén
Malin Johansson
Anette Wallstedt
Stina Andersson

Alingsås

Tarik Hamakarim
Cathrine Westby
Britt-Marie Johansson

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Niclas Andersson
Ida Gustafsson

Art Clinic Jönköping

Niclas Andersson
Marie Claar

Arvika

Karin Tholén
Hans Lyrholm
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Bollnäs

Mikael Davidsson
Ales Berce
Helena Larsson
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Borås

Christan Kopp
Karin Ståhl
Carin Egelhof

Capio Artro Clinic

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Karin Lundh
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Capio Movement

Linus Nilsson
Anna-Karin Ivansson
Linda Wirström

Capio Ortopedi Motala

Jonas Holmertz
Bengt Horn
Carin Hjelm
Anna Alsterqvist
Sarah Fransson
Malin Engvall
Jenny van Doorn
Jonna Stolt

Capio Ortopediska

Huset

Johan Karlsson
Ingra Sandell
Ann-Christine Karlsson
Louise Hultström

Capio S:t Göran

Filip Olsson Arthur
Tom von Oelreich
Anneli Engström
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Carlanderska

Reza Razaznejad
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Carlanderska-SportsMed

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Adad Baranto

Danderyd

Olof Sköldenberg
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Annika Wallier
Åsa Hugo Eriksson
Lena Braun
Eva Jansson

Eksjö

Predrag Jovanovic
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Lazar Popov
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Cecilia Jakobsson
Marita Eriksson

Gävle

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Hampus Stigbrand
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Halmstad

Bo Granath
Daniel Stam
Linda Csaki-Lund
Zara Petzäll
Charlotte Kader

Helsingborg

Sadik Tözmäl
Britt Berlin

Hermelinen

Tomas Isaksson
Sanna Gärdelid

Hudiksvall

Anders Eriksson
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Hässleholm

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Anneli Korneliusson
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Jönköping

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Karlshamn

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Karlskoga

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Gunn Enoch
Ulla Laursen
Anna Igelström

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Graphic design

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In collaboration with

Center of Registers Västra Götaland

Region Västra Götaland

Swedish Orthopaedic Association

Lund University

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